Sir Andrew Clark Bart

with the kind regards
of
J. M. Williamson

_____

Ventnor
Feb. 1889

PULMONARY PHTHISIS.

PULMONARY PHTHISIS

ITS ETIOLOGY, PATHOLOGY,
AND TREATMENT.

BY

ALEX. JAMES, M.D., F.R.C.P.Ed.,

LECTURER ON THE PRINCIPLES AND PRACTICE OF MEDICINE IN THE SCHOOL OF MEDICINE,
EDINBURGH ; ASSISTANT PHYSICIAN EDINBURGH ROYAL INFIRMARY.

To JAMES MATTHEWS DUNCAN, Esq.,
A.M., M.D., LL.D.

My Dear Dr Duncan,

I have a genuine pleasure in dedicating this book to you, because I feel that thus I may in some measure express my appreciation of the teaching which, as one of your pupils, I had the good fortune to enjoy. This pleasure is, however, somewhat alloyed by the fear that the performance may be found to fall far short of what you might justly have expected. I can only beg of you to believe that I as cordially ascribe to your good influence any merit which it may be deemed to possess, as I unfeignedly attribute to my own deficient power and knowledge its many shortcomings.

For this addition to the numerous works on the subject of Consumption, the apology which I offer is a very old one, viz., the trust that I may have been able to add something to the sum of our knowledge of this disease. Whether or not I have succeeded in doing this, remains to be seen ; I have at any rate tried to bear in mind the maxim, that in order to do what has never been done, methods must be used which have not yet been employed.

Recognising this, I have endeavoured to apply more closely than to my knowledge has been done hitherto, the ascertained facts of physiology to the elucidation of the phenomena of this disease. In connection, for example, with the Etiology of Phthisis, I have, in the first place, investigated and discussed the special liability of the different tissues and organs to tubercular disease at different periods of life, I have noted

the differences in the conditions of life in different individuals and in the sexes, and I have considered from the physiological aspect, the effects on the organism of various other diseases, and the special conditions under which, in health, the lungs perform their functions.

In connection with the Pathology, an interpretation of the morbid appearances has been sought for in the recognised effects of irritants on living tissues, and in the relationship between micro-organisms and the animal body in health and disease.

From the points of view of the Etiology and Pathology, the Symptomatology has next been discussed, and, realising that Phthisis stands forth prominently as a disease with regard to which the Pathological Physiology should form the basis of therapeutics, I have endeavoured to associate as closely as possible the Symptomatology and Treatment.

The lines of reasoning along which I have been led, and the conclusions at which I have arrived, I shall not here attempt to summarise. That there may be in them something, however insignificant, which will merit your approval, I venture most sincerely to hope, for I shall then have the great satisfaction of knowing that my humble efforts to profit by your precepts, and to follow your example, have not been altogether in vain.

I remain,

With much esteem,

Your faithful Pupil and Friend,

ALEX. JAMES.

44 MELVILLE STREET,
EDINBURGH, *November* 1888.

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PULMONARY PHTHISIS.

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CHAPTER I.

ETIOLOGY OF PHTHISIS.

PULMONARY phthisis is due to a condition of deficient nutri-
tion, permitting the growth and reproduction in the lung
tissue of a lower form of organised life. This condition of
deficient nutrition may be the result of many and diverse
causes. It may be inherited, as where there is a family history
of consumption ; it may be innate, where there is a family
history of cancer, insanity, diabetes, &c. ; or it may be
acquired, as the result of noxious surroundings, of unhealthy
occupations, or of acute or chronic disease.

In all these circumstances this abnormal condition is to be
regarded as being brought about by general or constitutional
causes ; it is to be remembered that its occurrence may be the
result of what may be termed individual ones. Thus, phthisis
shows a tendency to occur at certain periods of life, it mani-
fests differences as regards the sexes, it tends specially to
affect individuals of a certain physique, chest configuration,
stature, &c.

Under the head of *etiology*, all these have now to be sub-mitted to detailed consideration. In proceeding to this part of the subject, it might seem appropriate to adhere generally to the division above given, and to discuss, first, the general or constitutional factors, and, secondly, what have been termed the individual factors in the production of this so-called condition of deficient nutrition. They will, however, severally be discussed in the following order :—Age, stature, sex, influence of disease, physical conditions of the chest, season, heredity, constitution.

This general arrangement is preferred, first, because it will defer the consideration of the more involved and less under-stood etiological factors to the end ; secondly, because it will, I believe, enable the thread of the argument as regards the etiology to be more easily followed to its conclusion ; and thirdly, because it will get quit of the difficulty of having to decide as to whether any given etiological factor should be termed a constitutional and general or an individual one.

Age in connection with Pulmonary Phthisis.

The curve *a*, Diagram I., which is constructed to show the mortality from phthisis in Scotland proportionate to the number of individuals living at different ages, demonstrates that the disease rapidly increases after the fifteenth year, reaches a maximum at the twenty-fifth, maintains this till the thirtieth, and then gradually diminishes. Concerning this curve, however, certain remarks are necessary.

First, it does not correspond with the curve constructed from similar data by Hutchinson, which shows the maximum mortality to occur about the fiftieth year, yet in the main it corroborates the statement that, in the later years of life, the disease is much more common than is generally supposed.*

* "The Spirometer, Stethoscope, and Scale Balance, &c.," pp. 43 and 46 ; English Registrar-General's Fifth Annual Report ; and Sieveking's " Medical Adviser in Life Assurance," 2nd edition, p. 93.

DIAGRAM I, to show the mortality from Tubercular Meningitis, Tabes Mesenterica, and Pulmonary Phthisis, relative to persons living at different ages. See Table I.

Tubercular Meningitis (Males), ————
Tabes Mesenterica (Males), ————
Pulmonary Phthisis (Males), ————
    „   „   (Females), ...
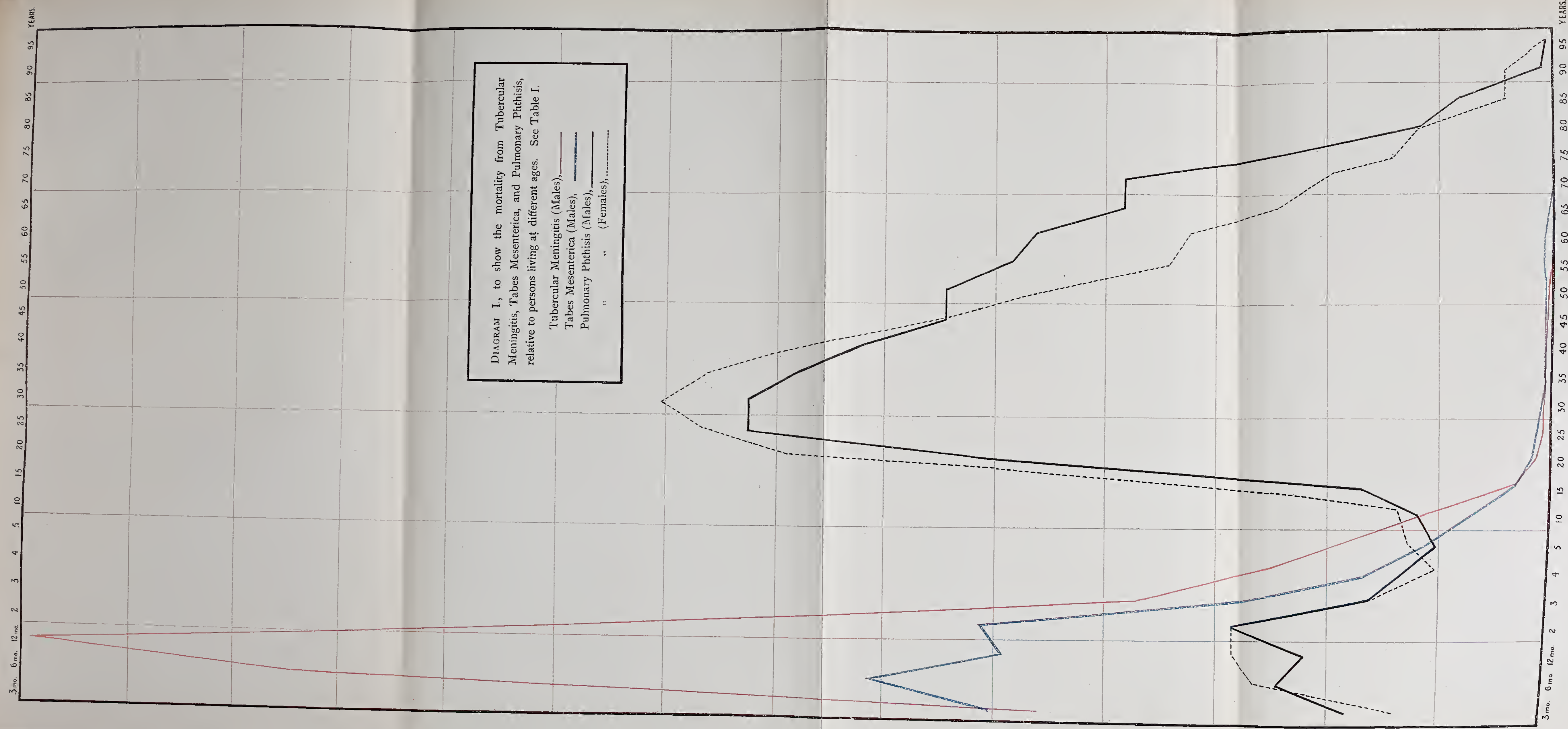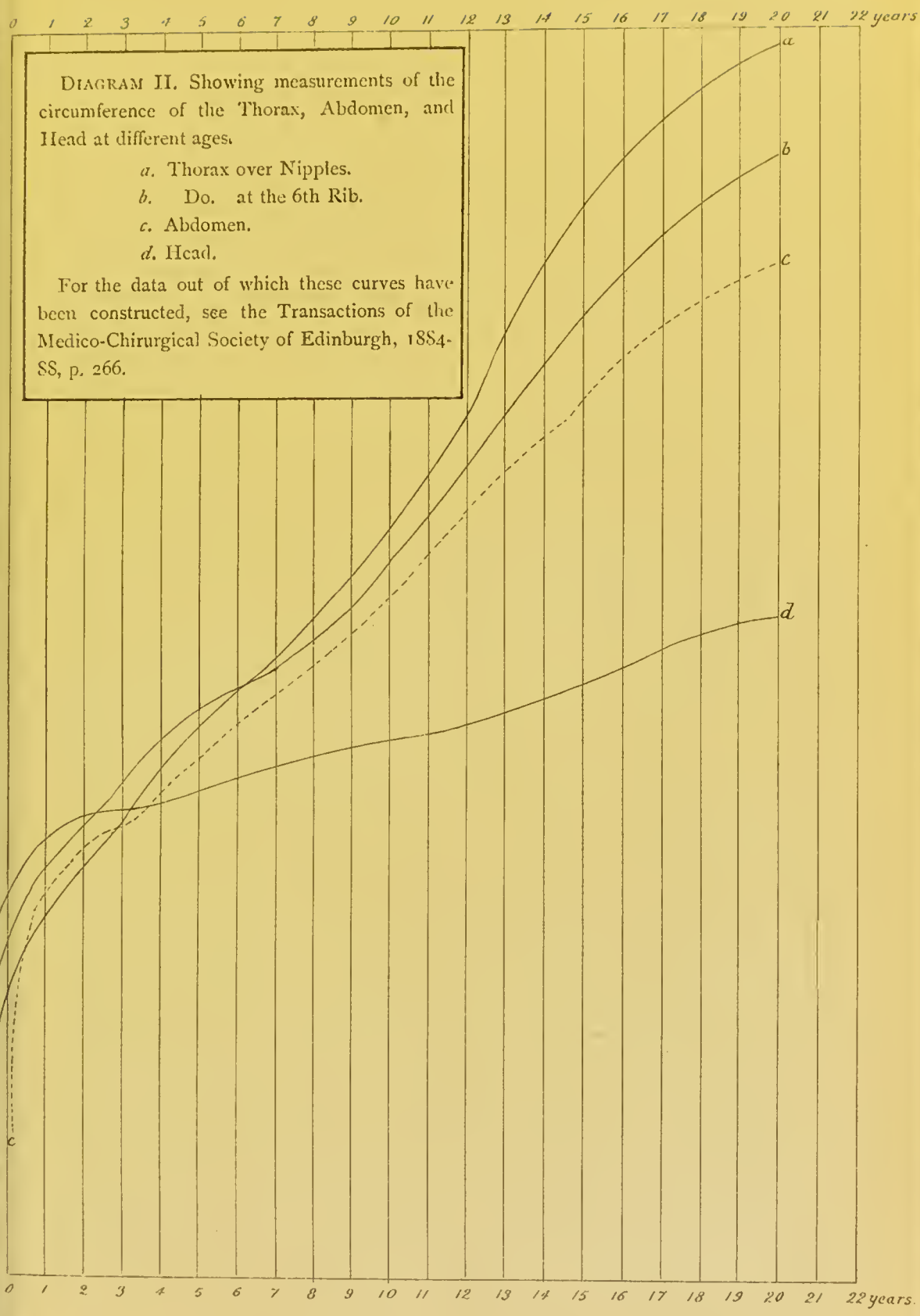
DIAGRAM II. Showing measurements of the circumference of the Thorax, Abdomen, and Head at different ages.

      a. Thorax over Nipples.
      b.   Do.   at the 6th Rib.
      c. Abdomen.
      d. Head.

For the data out of which these curves have been constructed, see the Transactions of the Medico-Chirurgical Society of Edinburgh, 1884-88, p. 266.

a

b

c

d

c

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 years.

Secondly, comparing it with hospital statistics, that is to say, with the ages at which phthisical patients usually present themselves in hospitals, a difference may again be found. Thus, of 300 phthisical patients in the Edinburgh Royal Infirmary, the greatest number were between the ages of thirty and forty years. That this difference should exist is peculiar, and specially so when it is remembered that the data from which the curve has been constructed represent deaths, whilst hospital statistics represent cases still living. It is interesting, however, because, as we shall note more fully by-and-bye, similar differences are found to present themselves as regards age in cases of brain and intestinal tubercle.

Thirdly, whilst demonstrating a low phthisis mortality from the fourth to the tenth or twelfth year, the curve indicates a somewhat higher death-rate from this cause during the earlier years and months of life. Whilst fully recognising that true phthisis does frequently occur at those periods, I feel sure that, by errors of diagnosis, this high death-rate may be explained, and that to catarrhal pneumonia, bronchitis, lymphatic gland tubercle, and acute miliary tubercle, many of those deaths should more properly have been ascribed.

It is next to be observed that, pulmonary phthisis occurring to the greatest extent between the twentieth and thirtieth years, is most apt to show itself at the period when growth passes into maturity ; that is to say, that as far as age is concerned, the period at which lung tissue nutrition is least able to resist the inroad of the bacillus, is precisely the period at which the excessive nutritive power necessary for growth has been expended. A glance at Diagram II., curves *a* and *b*, shows that the lung growth corresponds as regards time with that of the body generally ; that with it growth is going on vigorously till the twenty-first or twenty-second year. Hence the comparative absence of phthisis in the first ten years, its development in the second, and its comparative frequency in the third, seem to indicate a relationship between the

capability for harm of the bacillus and the nutritive power of the lung tissue.

This tendency to tubercular disease at a period when the assimilative power required for growth becomes or is becoming expended, is well seen in connection with other organs and tissues, of which I would specify the brain, intestines, larynx, testes, and joints. All these merit detailed consideration.

Brain Tubercle.

Curve *b*, Diagram I., is intended to show the mortality from tubercular meningitis in Scotland at different ages. According to it, this affection is comparatively infrequent during the first months of life, reaches its maximum about the end of the first year, then declines very rapidly to the fifteenth year, and then more gradually till about the fifty-fifth year of life. Its occurrence after this age is so rare (see Table I.), that it is neglected in the curve.

Hospital statistics of this disease show a slightly different result. Thus the following data have been collected from the case books of the Edinburgh Children's Hospital and from the Pendlebury abstracts (1882, 83, 84, and 85):—

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 years.
1	6	12	12	18	14	7	8	7	1	7	0	0	0	0 Edinburgh (93 cases).
0	6	1	0	4	6	8	5	8	0	0	0	2	0	1 Pendlebury (41 cases).
1	12	13	12	22	20	15	13	15	1	7	0	2	0	1 Total (134 cases).

Rilliet and Barthez have given the following :—

	Paris.	Geneva.	Totals.
5 months, ...	0	1	1
9 months, ...	0	1	1
1 year to 2½ years, . .	4	13	17
3 years to 5½ years, .	11	23	34
6 years to 7½ years, .	7	16	23
8 years to 10 years, . .	10	5	15
11 years to 15 years, . .	4	3	7
	36	62	98

TABLE I.—Mortality per cent. from Tubercular Meningitis, Tabes Mesenterica, and Pulmonary Phthisis, relative to persons living at different ages (Registrar-General's (Scotland) Reports, average of ten years, 1876-1885). M=Males. F=Females.

	3mo.	6mo.	12mo.	2yrs.	3	4	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95 yrs.
Tubercular Meningitis,																									
M.	·229	·570	·699	·422	·184	·128	·093	·058	·019	·007	·003	·002	·002	·001	·001	·001	·001								
F.	·184	·483	·582	·346	·153	·112	·097	·056	·018	·007	·002	·001	·001	·0005	·0008	·0005	·0004								
Tabes Mesenterica.																									
M.	·250	·302	·247	·254	·133	·082	·058	·035	·019	·009	·006	·003	·002	·002	·002	·002	·003	·003	·002	·0009					
F.	·201	·240	·209	·232	·106	·060	·044	·030	·020	·010	·006	·004	·004	·002	·003	·002	·001	·003	·001	·003					
Pulmonary Phthisis.																									
M.	·09	·12	·11	·14	·08	·06	·05	·06	·08	·25	·36	·36	·34	·31	·273	·274	·24	·23	·19	·19	·12	·06	·04	·03	·02
F.	·07	·13	·14	·14	·08	·05	·06	·07	·14	·34	·38	·40	·38	·33	·27	·22	·17	·16	·12	·10	·07	·06	·02	·02	·002

Hospital results, therefore, whilst corroborating the Regis-
tration statistics as regards the infrequence of tubercular brain
disease at the very beginning of life, indicate for it a some-
what later maximum mortality, viz., about the fourth year.
Which of the two sets of data is the more trustworthy, it is
hard to say. We have to remember on the one hand that in
the Registration ones errors of diagnosis are certainly more
frequent, and on the other, that the hospital ones are incom-
plete, children's hospitals dealing only with patients under
twelve years of age. We have further to remember that, in
many cases where death has occurred from tubercular
meningitis, a tubercular lesion elsewhere, in intestine, pleura,
lung, joint, or gland has been the original lesion.

Taking all this into consideration, however, we are probably
safe in assuming that brain tubercle is relatively infrequent at
the very beginning of life, and that though we cannot say
when it reaches its maximum, it is specially frequent about
the second and third years. The connection between this
and brain growth is clear, for as curve *d*, Diagram II., shows,
this organ has practically completed its growth about the
third year, *i.e.* after the third year the excessive nutritive
power required for its growth is practically exhausted.

Intestinal Tubercle.

The association of this with a period of life when the
excessive nutritive power required for growth has in the case
of the abdominal viscera attained a maximum, will, I believe,
be admitted, when all the data are examined. At first, how-
ever, the connection does not appear so complete as in the
case of lung and brain tubercle.

Curve *c*, Diagram I., shows "Tabes Mesenterica" to reach its
maximum in the second three months of life, to fall towards
the end of the first year, again to rise, though slightly, in the
second year, and to fall thence, at first rapidly and then more
gradually, persisting however till about the seventieth year,

after which its occurrence is so rare that it is neglected in the curve. Hospital statistics, as in the case of lung and brain tubercle, indicate its maximum frequency as occurring at a later period. Thus the Edinburgh Children's Hospital and the Pendlebury abstracts yield data as follows :—

0	1	2	3	4	5	6	7	8	9	10	11	12	13 years.	
0	0	3	4	5	3	1	3	2	3	1	2	0	0	Edinburgh (27 cases).
2	7	6	4	10	4	3	5	6	2	1	0	2	1	Pendlebury (53 cases).
2	7	9	8	15	7	4	8	8	5	2	2	2	1	Total. (80 cases).

The following are Rilliet and Barthez' statistics :—

	AGE.				
	1 year to 1½ years.	3 years to 5½ years.	6 years to 10 years.	11 years to 15 years.	Totals.
Stomach, . . .	4	11	5	1	21
Small Intestine, .	25	34	49	26	134
Large Intestine, .	9	17	21	13	60
	38	62	75	40	215

Concerning these data it is to be remarked, first, that under the head of "Tabes Mesenterica," in the Registration statistics, are classed many cases of chronic diarrhœa and tympanites in children, in which no true tubercular disease exists; secondly, that in the Children's Hospital statistics the absence of cases above the twelfth or thirteenth year has to be allowed for; and thirdly, that in both sets of statistics an element of confusion and possible fallacy is introduced, by the fact that cases of primary intestinal tubercle may terminate in tubercular meningitis or pulmonary phthisis, and be designated accordingly.

Taking, however, everything, or what appears to be everything, into consideration, it seems indubitable that intestinal tubercle is to be associated with a later period of life than brain, and earlier than lung, tubercle. In the Registration statistics the curve of "Tabes" is seen to cross that of tubercular meningitis about the fifteenth year, and retaining its lead to persist till the seventieth year. In the combined

Edinburgh and Pendlebury statistics, though the greatest
number of intestinal cases are met with at the same age as
that of the brain cases, viz., at the fourth year, yet, after that
age a greater proportion of the former are recorded than of
the latter.   It seems, therefore, probable that the data of
Rilliet and Barthez come nearest the truth, and that between
the sixth and tenth years the greatest liability to this localisa-
tion of tubercle exists.

Comparing this with data showing the growth of these vis-
cera, a connection can again be recognised.   Thus, Liharzik,*
in giving the following as the relative dimensions of the ab-
dominal cavity :—

	Birth.	21st mo.	7½ yrs.	Adult.
Belly, . . .	100	160	240	260

indicates that in the case of these parts, the greatest growth
activity is over by the seventh year, and curve *c*, Diagram
II., showing the circumference of the belly at different ages,
though it seems to demonstrate that the abdominal viscera
continue their growth till adult age is attained, demonstrates
also that about the sixth year the growth of the abdominal
viscera is exceeded in activity by that of the thoracic.   We
are, therefore, justified in concluding that the store of
assimilative energy, which enables the intestines gradually to
increase in size till their full bulk is attained, is used up later
than in the case of the brain, and earlier than in that of the
lungs, and that therefore intestinal shows itself later than
brain and earlier than pulmonary tubercle.

Tubercle of the Larynx.

In 29 of such cases (22 males and 7 females), in the great
majority of which the laryngeal was the primary mischief,
the ages were as follows :—

10	15	20	25	30	35	40	45	50	55	60 yrs.
0	3	5	5	8	4	1	1	0	1	1

* " Handbuch der Kinderkrankheiten," Gerhardt, vol. i., p 272.

Further, the extreme rarity of laryngeal phthisis in children is referred to by Heinze, he finding only 2·3 per cent. of this affection in children under nine years.*

Laryngeal tubercle, therefore, is most apt to occur after puberty—*i.e.*, after the larnyx has attained its full size.

Tubercle of the Testes.

Of such I have been able to collect 34 cases, occurring at the following ages :—

10	15	20	25	30	35	40	45	50	55	60 yrs.
4	6	7	7	2	3	2	1	0	1	1

Of Salleron's 47 cases, as quoted by Curling, the ages were—36 between twenty and thirty, 6 between thirty and forty, 4 between forty and fifty, and 1 between fifty and sixty. Derived, however, from observations made solely among soldiers, they are limited to the military age. It is sufficiently clear, however, that testis tubercle occurs mainly in the ten or fifteen years after puberty—*i.e.*, after the growth of the testis has attained its maximum.†

The relationship between tubercular joint disease and bone growth has next to be considered. Table II. shows the ages at which patients with disease of the hip, knee, ankle, shoulder, elbow, and wrist, showed themselves in 530 cases which I have collected from the ward journals of the Edinburgh Royal Infirmary, and the diagram represents this in curves, five in number, not six, as the shoulder and wrist have been taken together. This has been done because those joints correspond closely as regards the periods of ossification of the bones which compose them, and because the number of cases of disease of the shoulder joint is comparatively small.

The curves show that in the lower limb the hip is the

* Gottstein, " Diseases of the Larynx," translated by Dr M'Bride, p. 202.
† " Diseases of the Testis," 4th edition, p. 337.

TABLE II.—Shewing the ages in 530 cases of Strumous Joint Disease.

0	5	10	15	20	25	30	35	40	45	50	55	60	65 yrs.		Totals.	
7	39	14	10	6	3	2	1	2	1					=	85 Males.	
4	11	13	3	4	3	1								=	39 Females.	Hip.
11	50	27	13	10	6	3	1	2	1					=	124 Total.	
7	16	24	22	15	5	3	3	2	2	2	1	1	1	=	104 Males.	
10	10	10	14	6	2	1	3	0	1					=	57 Females.	Knee.
17	26	34	36	21	7	4	6	2	3	2	1	1	1	=	161 Total.	
3	9	16	11	7	5	2	1	1	1					=	56 Males.	
3	8	4	6	4	4	1	0	2						=	32 Females.	Ankle.
6	17	20	17	11	9	3	1	3	1					=	88 Total.	
0	0	1	2	4	2									=	9 Males.	
3	0	0	1	4	0	1	1	1	0	0	1			=	12 Females.	Shoulder.
3	0	1	3	8	2	1	1	1	0	0	1			=	21 Total.	
7	12	6	13	5	3	4	0	3	2	1	1			=	57 Males.	
4	7	6	8	3	5	1								=	34 Females.	Elbow.
11	19	12	21	8	8	5	0	3	2	1	1			=	91 Total.	
1	1	3	4	7	3	2	3	1	0	2				=	27 Males.	
0	5	0	4	7	0	0	1	0	0	0	0	1		=	18 Females.	Wrist.
1	6	3	8	14	3	2	4	1	0	2	0	1		=	45 Total.	

Periods of Ossification of the Bones of the Limbs.   (Quain's Anatomy.)

Hip Joint. { The parts which meet in the acetabulum unite about the 16th or 17th year. { The head and shaft of the femur unite about the 18th or 19th year.

Knee Joint. { The epiphysis and shaft of the femur unite after the 20th year. { The epiphysis and shaft of the tibia unite in the 21st and 22nd year.

Ankle Joint. { The epiphysis and shaft of the tibia unite in the 18th or 19th year. { The epiphysis and shaft of the fibula unite in the 21st year or later.

Shoulder Joint. { Parts forming scapular portion unite from 22nd to 25th year. { The epiphysis and shaft of the humerus unite in the 20th year.

Elbow Joint. { Capitellar and trochlear nuclei of the humerus unite with the shaft in the 16th or 17th year. { The epiphysis and shaft of the ulna unite about the 17th year. { The epiphysis and shaft of the radius unite about the 17th or 18th year.

Wrist Joint. { The epiphysis and shaft of the radius unite about the 20th year. { The epiphysis and shaft of the ulna unite about the 20th year.

Diagram III constructed from Table II., showing the Ages in 530 cases of Strumous Joint Disease.
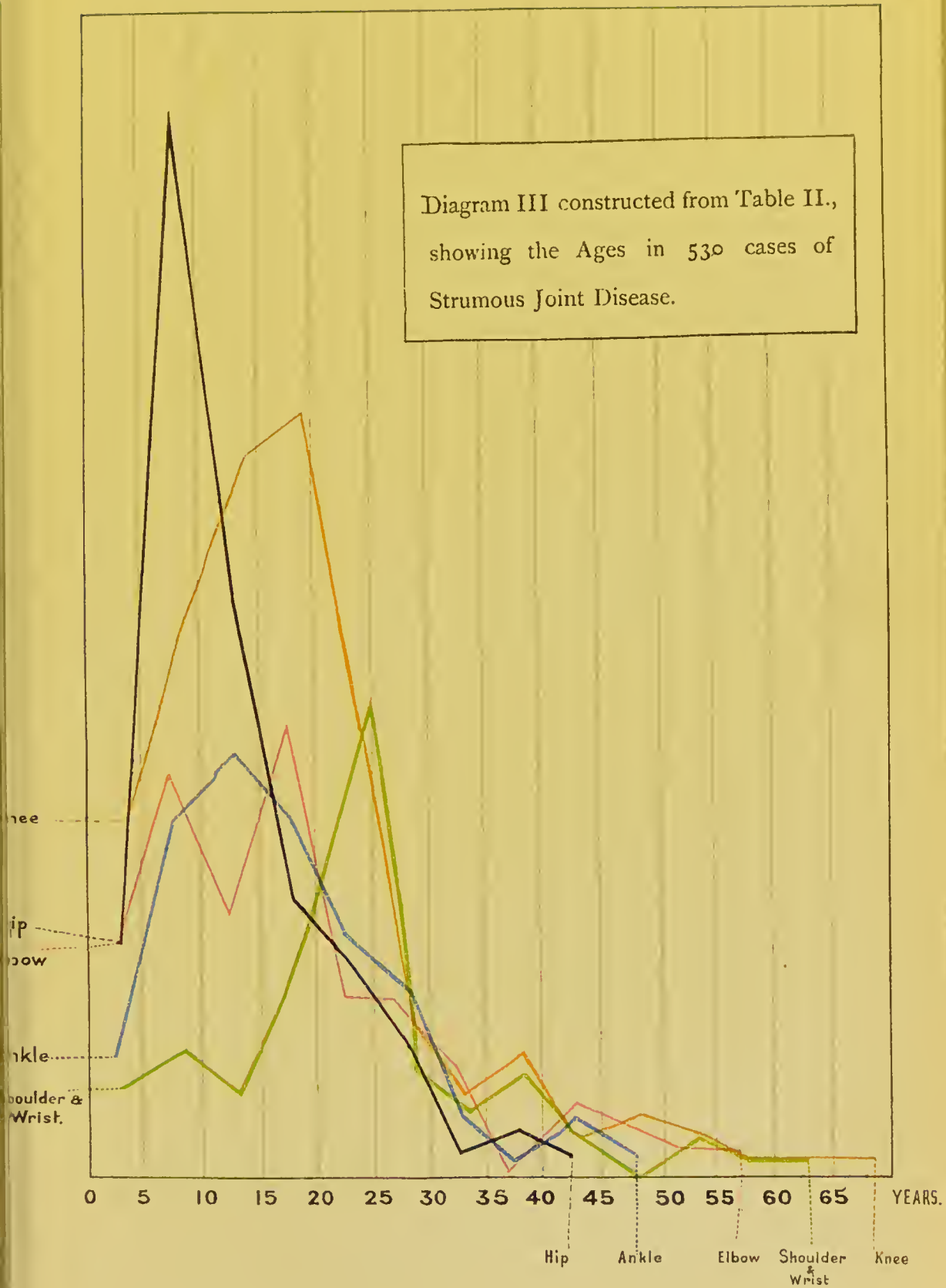
earliest to become affected, next in order is the ankle, and lastly the knee; whilst that in the upper limb, the elbow, though presenting a peculiar drop between the tenth and fifteenth years (shown also to a slighter extent in the wrist) is earlier than the other two joints.

Turning now to the ages at which in these various articulations bone growth and development are completed, we find it to occur in the lower limb, first in the hip, next in the ankle, and lastly in the knee; and, again, that in the upper limb, the bones forming the elbow joint are completely ossified before those of the shoulder and wrist.

It will thus be seen that though we cannot, in the case at least of all the joints, state that their maximum liability to tubercular disease exists exactly at those periods of life when the excessive nutritive energy required for growth is expended, we can yet clearly trace the connection between the affection and this nutritive power. The bones forming all these joints have at birth a store of assimilative energy which enables them to go on growing till certain periods of life : in the case of the hip, till between the sixteenth and nineteenth years ; of the ankle, the eighteenth and twenty-first ; and of the knee, the twenty-first or twenty-second, &c. When, therefore, this assimilative power is from constitutional or other conditions deficient, tubercular disease in them will show itself at corresponding periods, in the case of the lower limb, earliest in the hip, later in the ankle, and latest in the knee, &c. Indeed, when we reflect on the many and often accidental factors which play a part in the etiology of joint disease, that such a close correspondence between it and age should obtain, is probably as strong evidence in favour of our theory as any which has been adduced.

From all these data a general conclusion which may be drawn is, that tubercular deposit tends to occur in the various tissues at periods when the excessive nutritive power required for growth is becoming, or has become, exhausted,

and that, therefore, pulmonary tubercle is specially liable to occur about the twenty-fifth or thirtieth years.

[Such a connection between liability to tubercular disease and growth suggests experimental inquiry, but at present I must confine myself to statistical evidence. As illustrating, however, the excessive nutritive power of early life, is the fact that in such an animal as the newt the power of reforming limbs and tail exists while growth is going on, and rapidly diminishes as age advances.]

But to this general conclusion certain possible objections must be stated and answered.

(1.) That tubercular disease of the lymphatic gland structures, bronchial, mediastinal, mesenteric, submaxillary, &c., tends to occur during the earlier years of life. This may be explained by the fact that these lymphatic glands reach their maximum size during these earlier years.

(2.) That exception may be taken to the data which have been given as regards tubercular diseases, in that whilst in lung, intestine, larynx, testis, and joints, the tubercular processes recorded are chronic, that occurring in the brain, is acute (tubercular meningitis.) It is to be remembered, however, that slow-growing tubercular tumours of the brain are most apt to occur in early years, and that the two morbid changes—chronic tubercular deposit and softening, and acute tuberculosis—are closely allied.

(3.) But the fact that the acute miliary tubercular process, occurring generally among the viscera, is a more common associate of localised tubercular lesions in those early years when growth is active, may perhaps be looked upon as the strongest argument against the theory. There is no doubt, however, that though the occurrence of acute miliary tuberculosis is to be regarded as denoting deficient nutritive power, yet it is a disease dependent on infection from some tubercular focus to a much larger extent than is the chronic process. It will, therefore, occur most readily when lymphatic

tissues, that is to say, tissues concerned in resorption are functionally most active.   This is a case we have just seen in early life.

But, next, it will be observed that the curve of phthisis having reached its highest at the twenty-fifth and thirtieth years, slowly, but surely, falls ; that at the eightieth year it is about as low as at the tenth, and that at the close of life it is lowest of all.   (This at least is the case in the Scottish Registration Statistics ; according to others, a somewhat different distribution pertains ; all, however, show a diminution in the liability to the disease after the fiftieth year.—*See* p. 2.) Further, it will be observed that this diminution with age is not peculiar to the lungs, but that tubercle elsewhere (brain, intestines, larynx, testis, and joints) behaves similarly.

This is probably to some extent connected with the physiological fact, that when growth stops development begins, and that these processes are essentially different from one another.* Growth consisting in an increase in mass, and development implying a change in structure, it is conceivable that when this latter has occurred any defective assimilative power may be less likely to be felt.   In the case of the bones this can, perhaps, most easily be understood.   It can be conceived that during the period when the cells of the epiphysial cartilages are rapidly proliferating and ossifying, the risk of lesion from any disturbance of nutrition will be greater than after complete ossification has occurred.   Further, associated probably with the modification in the assimilative process which the developmental change brings about, the lymphatic system diminishes in activity, and consequently there is in the later years of life less risk from the extension of any tubercular mischief. Lastly, though as age advances the nutritive power becomes less and less vigorous, yet in the case of the lung the tendency to emphysema will tend to favour functional

* Of course, these processes are being carried on together to a considerable extent.   Compare Herbert Spencer on Education, p. 181.

activity of its tissue, and so render it less liable to tubercular change.

Stature in connection with Pulmonary Phthisis.

From a previous paper I quote the following statistics :—*

Stature of patients admitted into the Royal infirmary (1586 male adults).

Ft. In.		Phthisis (237 cases). Per cent.	All other diseases (1349 cases). Per cent.
5	2 and under.	2·1	3·0
5	3 ,,	1·6	2·3
5	4 ,,	5·9	6·5
5	5 ,,	8·8	10·9
5	6 ,,	11·8	18·5
5	7 ,,	13·9	17·0
5	8 ,,	16·8	13·1
5	9 ,,	14·7	10·2
5	10 ,,	12·6	8·4
5	11 ,,	5·0	4·0
6	0 and over.	6·3	4·2

The phthisical cases are here shown to be the taller, and though their number may seem too small to warrant deductions, I venture on the following :—

(1.) That as tall individuals have a distinctly greater respiratory capacity than short ones, any conditions which render life sedentary must in them produce in a special degree lessening of the respiratory functional activity. Inasmuch, however, as a lessened respiratory functional activity is a fruitful cause of that defective state of nutrition which disposes to phthisis, this means in the tall a greater liability to that disease.

(2.) That apart from the curious and as yet unexplained

* *Edinburgh Medical Journal*, October 1885.

physiological connection between the respiratory capacity and stature, the tall and physically more perfect specimens of humanity—*i.e.*, the products of fresh air, sunlight, and physical exercise,—may be regarded as being less accommodated to town life, and therefore more prone to suffer from its disadvantages. The negro and Indian, healthy and free from phthisis so long as they exist in their native wilds, fall victims to it very readily when brought within the confines of civilisation ; and physicians in large towns too frequently meet with examples of young men of specially good physique from country districts, or from more favoured foreign lands, succumbing to phthisis, whilst their often less robust looking town-bred neighbours remain free.

Of course, to all this there are many qualifications. A stature above the average means, *ceteris paribus*, an assimilative power above the average, and is often associated with the greatest constitutional vigour, whilst the same conditions which in towns lead to diminution in stature, frequently lead also to a diminished resistance power on the part of the tissues to tubercular and other forms of disease ; and to such an extent is this the case, that practically, town populations are being to a large extent continually recruited from country districts. Viewed, however, in the light of the above statistics and deductions, the diminution in the stature of men in the large towns and manufacturing districts of the British Islands must, like all Nature's acts, be regarded as representing in the circumstances a salutary process.

Sex in Connection with Pulmonary Phthisis.

When we look for data upon which to form an opinion as to the relative frequency of pulmonary consumption in the sexes, we find results which are decidedly conflicting. From some writers, as Williams, Bennett, Pollock, it might be inferred that the disease preponderated in males : others, as Louis, Laennec, Walshe, Hutchinson, give evidence of an

increased liability to it in the female sex ; whilst others again, as Niemeyer, Bristowe, Ruehle, Andrew, consider that no distinction as regards relative frequency can be drawn.

Further, not only have such contradictory statements been made, but theories have been put forward by many physicians of eminence in explanation of a supposed greater liability to consumption in one or the other sex.   Those who believed it more common in men ascribed it to occupations and greater liability to exposure, and, indeed, to all injurious influences ; whilst among those who believed it more common in women, a very great difference of opinion has existed.   By some it has been ascribed to something inherent in the individual, by others to the external conditions or surroundings.   By the former such expressions as " greater original delicacy of constitution," " less power of resistance," "greater tendency to anæmia," are made use of as regards women, and the evil effects of confinements, lactation, &c., are brought into prominence ; whilst by the latter, the more sedentary life of women, their bad physical education, the wearing of stays, exposure of the upper part of the chest, &c., have been looked upon as the more probable cause.

In order to discover if any data of use in elucidating this question could be obtained by studying the relative frequency of the affection in the sexes in the different districts of Scotland and England, I have examined the reports of the Registrars-General for a series of years on this subject, and the results thus obtained I now propose to consider in detail.

[The data as regards the liability of organs, other than the lungs, to tubercular disease, appear too discordant to warrant any general conclusion.   Thus brain tubercle is more common in males ; intestinal more common in males in early life, more common in females after the tenth year ; and laryngeal tubercle is more common in males.   Hospital data show joint disease to be much more common in males.]

In the first place, if we compare the mortality from phthisis in Scotland with the general mortality in the sexes, we find

results which are sufficiently conclusive. The Registrar-
General's returns for Scotland for the ten years 1871 to 1880
average as follows :—

	Males.	Females.
Total yearly deaths per 1000, . .	22·58	20·73
Yearly deaths from phthisis per 1000, .	2·36	2·52

Inasmuch, then, as the total death-rate in Scotland is
greater in men than in women, whilst the death rate from
phthisis is greater in women than in men, some special prone-
ness to this disease, as compared with other morbid condition,
ought to be found existent in women.

Secondly, the proportion of female to male phthisis
mortality is not the same, but, indeed, is markedly different
in different localities. This is shown in the following table,
which represents the average proportionate mortality from
phthisis in the sexes, in the five districts of Scotland for the
ten years 1871 to 1880.

Deaths from phthisis per 100,000 persons living :—

Principal Towns.		Large Towns.		Small Towns.		Mainland Rural.		Insular Rural.	
Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
293·9	311·7	277·8	315·6	227·8	249·4	172·3	177·6	201·0	163·4

From this we see that male phthisis is most marked in the
towns, less in the insular rural, and least in the mainland
rural; while female phthisis, although also most marked in
the towns, is less in the insular rural than in the mainland
rural. The relative liability to phthisis can, however, be
better demonstrated by reducing these numbers to percentages,
and if we do this, we find that for every hundred female deaths
from phthisis there are in the

Principal Towns.	Large Towns.	Small Towns.	Mainland Rural.	Insular Rural.
94·2	88·0	91·3	97·0	123·0
male deaths.	male deaths.	male deaths.	male deaths.	male deaths.

This shows that while in the town districts women are more
liable to phthisis than men, in the mainland rural this lia-

bility is less (*i.e.*, the liability of the sexes is more nearly equal), while in the insular rural districts the reverse is markedly the case.

If, now, we take the proportionate male to female mortality from all causes for the same periods, we get the following result :—

Percentage of male and female deaths in the five districts for the ten years 1871 to 1880.   Average :—

Principal Towns.		Large Towns.		Small Towns.		Mainland Rural.		Insular Rural.	
Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
2·775	2·467	2·575	2·341	2·167	2·003	1·757	1·680	1·665	1·557

If, now, again, we take these numbers in relative percentages, we find that for every hundred female deaths from all causes there are in the

Principal Towns.	Large Towns.	Small Towns.	Mainland Rural.	Insular Rural.
112·4	109·9	108·1	104·5	106·9
male deaths.	male deaths.	male deaths.	male deaths.	male deaths.

These results show that the general mortality is greatest in the towns, much less in the mainland rural, and least in the insular rural ; and that the female mortality is in all the districts less than the male, the difference being greatest in the towns, less in the insular rural, and least in the mainland rural.

As being of further use in connection with our subject, let us now take the birth-rate in the same districts.

Percentage of births to the population in the five districts for the ten years 1871 to 1880.   Average—

Principal Towns	Large Towns.	Small Towns.	Mainland Rural.	Insular Rural.
3·780	3·905	3·551	3·092	2·591

As was to be expected, it corresponds to the death-rate, *i.e.*, greatest in the towns, less in the mainland rural, and least in the insular rural.

From these tables it will be seen—1. That in the town

where the general mortality, the phthisis mortality, and the birth-rate are highest, there exists as regards general mortality the greatest excess of male deaths, and as regards phthisis mortality the greatest excess of female deaths.

2. In the mainland rural districts, where the general mortality and birth-rate are very low, and where the phthisis mortality is lowest, there exists as regards general mortality a less excess of male deaths, and as regards phthisis mortality a less excess of female deaths.

These differences between the town and mainland rural districts might readily be explained as follows :—In the latter the surroundings of the people will be better, so that the general health will be superior. Further, the occupations of the sexes will be more equal—the out-door life predominating, and the risk of injury to women from what may be termed errors of clothing will be practically non-existent. Lastly, the birth-rate being low will diminish the depressing effects of repeated pregnancies and lactation.

Still it is to be observed that the mainland rural districts, although so favourably placed, show a preponderance of female phthisis. Are we to suppose that this indicates that there is in women as compared with men that which has been vaguely termed a " less power of resistance " to disease ? If so, how can we associate this with the fact that the general mortality is less in the case of women ? Is it not rather the result of the fact, that although both sexes are favourably placed as regards phthisis in the mainland rural districts, yet women's life being more in-door is the less so of the two ?

But now let us consider the case of the

3. Insular rural districts. In these the general mortality and birth-rate are lowest, as is also the female phthisis mortality ; but the male phthisis mortality, higher than that of the mainland rural, though less than that of the towns, greatly exceeds the female phthisis mortality, being in this respect quite exceptional.

How, then, can we say that the greater liability of women to phthisis as a whole is due to this so-called "power of resistance" being less than in man, *i.e.*, is due to something innate in her constitution?   Is it not rather due simply to the circumstances in which society places her, circumstances most unfavourable to her in town and less so in country districts? Or is it not the case that the comparative freedom from phthisis which women enjoy in the insular rural districts is more apparent than real, *i.e.*, that men are there placed under exceptionally unfavourable conditions, and consequently suffer correspondingly, so that the greater innate tendency of women to the disease is more than counterbalanced?

Before considering this matter further, let us direct attention to the reports of the Registrar-General for England.   In these no groupings are made into principal, large and small towns, and rural districts, as in Scotland, but I have endeavoured to obtain what may fitly be compared with the town and rural districts of Scotland, by taking London to represent the former, and the counties of Dorset, Sussex, Hereford, Rutland, Huntingdon, Suffolk, and Wiltshire, to represent the latter. These selected counties are agricultural, and show the lowest death-rates of all the English counties,[*] they may therefore be reasonably compared to the mainland rural districts of Scotland.

In the first place, however, let us note the proportion of male to female deaths (*a*) from all causes, and (*b*) from phthisis, in England as a whole.

For the ten years 1872 to 1881 the average was as follows :—

	Males.	Females.
Total yearly deaths per 1000, . .	22·0	19·4
Yearly deaths from phthisis per 1000, .	2·14	1·99

* See Supplement to the 45th Annual Report of the Registrar-General, p. 18.

† A table given by Walshe, seems to show that this excess of male phthisis in England and Wales has not always existed. "Diseases of the Lungs," 4th Edit., p. 463.

It will here be observed that the general and phthisis mortality are both lower in England than in Scotland, but what we have specially to concern ourselves with is the fact that in England, whilst the general mortality as in Scotland shows an excess of males, the phthisis mortality does so also, differing from what we have seen to be the case in Scotland.

Reverting now to the selected town and county districts, we find that the average deaths from phthisis per 100,000 living for ten years (1871 to 1880) were in

London.		Selected Counties.	
Males.	Females.	Males.	Females.
304·2	208·4	186·2	192·1

If, now, we reduce these numbers to percentages, we find that for every 100 female deaths from phthisis there are in

London.	Selected Counties.
145 male deaths.	96·9 male deaths.

These results are somewhat different from what we might have expected, for they show in London, a typically urban district, a large excess of male phthisis. The selected counties, however, like the mainland rural districts of Scotland, show a slight excess of female phthisis.

Let us next consider the proportions of male to female deaths from all causes in these districts.

Percentage of male to female deaths from all causes for ten years 1871 to 1880 (average)—

London.		Selected Counties.	
Male.	Female.	Male.	Female.
2·48	2·07	1·89	1·70

Again, taking these numbers in relative percentages, we find that for every 100 female deaths from all causes there are in

London.	Selected Counties.
119 male deaths.	111 male deaths.

These results correspond with those of the towns and main-

land rural districts of Scotland in showing a greater general mortality of males, most marked in the urban district. The excess of male deaths, however, is much greater in the English returns.

To carry out the method previously pursued, I now add the birth-rate in these districts.

Birth-rate for ten years (1872 to 1881) per 1000 (average)—

London.	Selected Counties.
35·4	30·4

These, of course, correspond with what we have noted in Scotland, giving a higher birth-rate in town districts.

When, now, we compare the Scotch and English results, we find in some points a fairly close correspondence. In the towns the birth-rate, general mortality, phthisis mortality, and proportionate male to female general mortality, are high. In the mainland rural districts of Scotland, and in the selected counties of England, these are low ; and further, these districts correspond with one another in showing a similarly slight excess of female phthisis. In one important respect, however, the results in the two kingdoms do not agree,—as London, a town district, shows a marked excess of male phthisis.

What, therefore, can we now say in answer to the question as to the relative liability of the sexes to phthisis ?

It is evident that as regards data on which to form an opinion on this subject, those localities in which the general mortality and the phthisis mortality are lowest will give the most trustworthy results. Where these two averages are high, there must be some cause, some condition interfering with health, possibly affecting both sexes equally, much more probably affecting one specially. As to which sex is acted upon most injuriously in towns like London or Manchester, or in counties like Cornwall or Staffordshire, there need be no doubt ; and although I cannot explain why a town like

Manchester should show an excess of male, and Glasgow of female phthisis, I believe that the excess of male phthisis in the insular rural districts of Scotland can similarly be explained as the result of surrounding circumstances. The conclusion, therefore, which I would draw is, that women are rather more liable to the disease than men.

But how is this? Is it, as stated before, the result of something innate in the constitution of woman, or is it the result of her surroundings in the social organism?

To the latter view the data which we have discussed at page 19 would rather incline us, inasmuch as phthisis is a disease which emphatically tends to affect those who lead an indoor life. To draw a conclusion on this point, however, I do not think we are entitled, since similar discrepancies are met with in connection with physiological and pathological conditions with which the indoor life can hardly be supposed to have so much to do. For example, the proportion of male to female births is different in the town and rural districts of Scotland and England.

Proportion of male to female births for ten years 1871 to 1880. Females=100.

Scotland—

Towns.	Mainland Rural.	Insular Rural.
105·8 male births.	105·9 male births.	107·6 male births.

England—

London.	Selected Counties.
103·8	104·0

Again, similar differences in statistical results seem to occur in connection with insanity, at any rate in Scotland. Thus, in districts which may be regarded as corresponding with the registration ones, the proportion of male to female cases varies considerably, as shown by the following table, which gives the numbers of intimations during the ten years 1873 to 1882 (average) :—

	Edinburgh (chiefly Urban).		Peebles, Roxburgh, and Selkirk Counties(chiefly Mainland Rural).		Argyll (chiefly Mainland and Insular Rural).	
	Male.	Female.	Male.	Female.	Male.	Female.
Average number of pauper lunatics per 1000 population,	} 64·5	68·2	34·0	39·8	68·6	66·6
Proportion per cent.	100	105·7	100	116·3	100	97·6

This shows that in the district (Argyll) where insanity is most frequent, there is a preponderance of male cases; in the districts (Peebles, Roxburgh, and Selkirk) where it is least, a great preponderance of female cases; and that in a district (Edinburgh) which occupies, as regards frequency, an intermediate position, the proportion of male to female cases is intermediate, female preponderating. On the assumption that women are innately weaker than men, one could readily explain the difference between these proportions in the county of Edinburgh on the one hand, and those of Peebles, Roxburgh, and Selkirk on the other, as being due to business cares, alcohol, &c., causing greater disturbance in males in the former district. But this would not account for the state of affairs in the Argyll district.

Looking, as was done in the cases of phthisis, upon the localities in which the affection is least prevalent, as probably affording the more trustworthy data, we find that insanity is rather more common in women, and this, assuming the absence of fallacy in the data, therefore, might seem to indicate that the slightly greater tendency of women to phthisis is not the result of her more indoor life, but of some inherent peculiarity in her constitution. Still, as before mentioned, women are longer lived than men; and although this might be explained as being due to their surroundings, whilst rendering them rather more liable to phthisis, yet shielding them to a greater extent from other morbid conditions, we might also suppose that these surroundings, entailing less sunlight, oxygen, exercise, &c., are similarly capable of rendering them more liable to insanity.

The fact that the healthy country life, with its low general mortality, low phthisis mortality, and low birth rate, shows a slightly less proportionate number of female births, as well as this slightly greater liability of females to phthisis, could readily afford material for speculation. From such, however, no trustworthy deductions could, I believe, at present be drawn.

When we next consider the question of the relative age at which phthisis is most apt to occur in women, we find, as might be expected, some difference from the other sex. As the tables given by Williams[*] and Hutchinson[†] show, and as is borne out by the Registrar-General's returns (see Diagram I.), the disease is apt to occur earlier in women. Williams' table shows that whilst between 10 and 30 more women are attacked than men, after 30 the reverse is the case; and although, as the curve shows, the Scottish Registrar-General's returns do not quite correspond to this, the female cutting the male curve about the 45th year, they give sufficiently clear evidence of an important difference in this respect.

Why phthisis occurs earlier in woman may be probably explained by the fact of the earlier cessation of growth in her case as compared with man. Every one knows that, as Spencer puts it, " a girl develops in body and mind rapidly, and ceases to grow comparatively early. A boy's bodily and mental development is slower, and his growth greater. At the age when the one is mature, finished, and having all faculties in full play, the other, whose vital energies have been more directed to increase of size, is relatively incomplete in structure, and shows it in a comparative awkwardness, bodily and mental." That is to say, in the male the excess of assimilation is later in being exhausted, hence the later

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[*] " Pulmonary Consumption," p. 296.

[†] " The Spirometer, the Stethoscope, and Scale Balance, &c.," by John Hutchinson, M.D., London, 1852.

development of the phthisical tendency. But further, it is
noteworthy that, as the curve shows, after the age of forty-
five the tendency to phthisis on the part of woman becomes
less than that of man. For this there are several reasons.
In the first place, it is to be remembered that with the cessa-
tion of menstruation, that is to say, with the cessation of the
capability for reproduction, a less expenditure will occur.
Hence a greater tendency on the part of women* to produce
fat as age advances ; and this, together with the tendency to
emphysema, with which it is usually associated, indicates a
condition which renders the lungs less liable to the disease.
Further, the fact that after forty-five or thereabouts woman
is directly shielded from the exhausting effects of pregnancies,
lactation, and even of menstruation itself, is to be con-
sidered.

The greater liability to phthisis from which women suffer
seems to have associated with it a correspondingly diminished
duration ; *i.e.*, a correspondingly increased acuteness and
severity as compared with men. Whether this be the result
of a greater inherent weakness of constitution in woman, or
of her circumstances and surroundings in the social organism,
we need not again discuss. It is remarkable, however, that
Walshe † concludes that, although in hospital complete dis-
appearance of symptoms is more common in males, the general
result of treatment is more satisfactory in females. Seeing
that female cases are less likely to come under treatment at
an early stage, and that in hospital they are placed in pre-
cisely the same circumstances as males, this observation might
appear rather opposed to the view of there being a greater
inherent weakness in women. With this observation, however,
my own experience leads me to coincide ; and I believe it to
be explained by the fact of women being more accustomed
than men to indoor existence and want of exercise, and con-

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* Compare Paget, " Surgical Pathology," p. 82.
† Walshe, *ibid.*, p. 468.

sequently accommodating themselves more readily to a more or less confined hospital life.

That pregnancy is looked upon by the laity as exercising a beneficial effect on phthisis is well known ; and the works of Graves, Copland, Walshe, Pollock, &c., have given to this notion a scientific value. On the other hand, there are not wanting observers who not only deny this mitigating influence, but assert that the reverse is much nearer the truth, *i.e.*, that pregnancy renders the phthisical symptoms more severe. To such a conclusion Grisolle,* Lebert,† and Spiegelberg‡ have to a greater or less extent arrived, the latter stating also that the risk of hæmorrhage in phthisis is increased by pregnancy. In the face of such contradictions, it may appear questionable if it is worth while discussing this matter further, inasmuch as if it is doubtful whether pregnancy affects phthisis for better or for worse, any generalisations as to the etiology of phthisis obtained from a study of its connection with pregnancy can hardly be regarded as resting upon a secure basis. If, on the other hand, the common view of the phthisical symptoms and conditions being mitigated by pregnancy contains in it any truth, information as to the wherefore is evidently correspondingly valuable. On consideration of the subject, I am disposed, to a considerable extent, to believe in the old view ; and my reasons, apart from individual experience, are—

First, that in estimating the effects of pregnancy on phthisis, it is difficult to eliminate those of childbirth and lactation, which are undoubtedly injurious ; and, secondly, that the period of life at which pregnancy occurs most frequently is that at which phthisis is most apt to occur, and that con-

* "Archives générales de Médecine," série iv. tome 22, 1850, p. 41.
† "Archiv für Gynækologie," Band iv. s. 468 ; and "Klinik der Brustkrankheiten," Band ii., p. 404.
‡ "Handbuch der Geburtskunde," p. 265.

sequently the evil effects of pregnancy in a phthisical in-
dividual may be more apparent than real. Thirdly, that
pregnancy can act beneficially or injuriously in connection
with the onset and course of other diseases. Thus Clouston*
states that although there is an insanity of pregnancy, yet
there is no period in the life of a woman in which she is less
subject to insanity. Further, I have been fortunate enough
to witness the effects of consecutive pregnancies in alleviating
the attacks in spasmodic asthma, a disease on which the in-
fluence of pregnancy for good when manifested is obviously
much more patent than in the case of phthisis, which, steadily
progressive, as it is too apt to be, renders appearance of
amelioration or aggravation less marked.† Conversely the
causal connection of a prejudicial character between pregnancy
and skin and renal diseases, which is allowed to exist, may,
as we shall see later on, be made to afford further evidence in
favour of the common view.

In explanation of this real or supposed influence, various
theories have been brought forward, all of which, however,
may be classed in two divisions—(*a*) local, (*b*) general. Under
the first head the beneficial effects are to be attributed to the
abdominal tumour mechanically affecting the respiratory ap-
paratus; under the second, to the general effects on the
system induced by pregnancy.

According to the local theory, the abdominal tumour, by
pushing up the diaphragm and interfering with its action, in-
duces in the lungs a condition allied to that in which they
exist in emphysema, heart disease, ague-cake, &c., that
is, a condition congested, watery, and functionally more
active.

Unfortunately for this view, however, the respiratory capa-

* "Mental Diseases," p. 517.

† Reigel, however, states that in certain cases asthma may be brought on by
pregnancy, and disappear after confinement.—Ziemssen's "Cyclopædia," vol.
iv., p. 581.

city, as ascertained by the spirometer, is not so markedly
diminished in pregnancy as one would expect. Indeed,
Wintrich, Fabius, and Küchenmeister, concluded that it is
practically the same as in the non-pregnant state; and
Dohrn,* although he found out of 100 cases that in the
majority there was a certain amount of diminution during
pregnancy, yet that in some there was, twelve or fourteen
days after delivery, a respiratory capacity equal to or rather
less than there had been at the ninth month. Of course it
may be readily supposed that a woman has not the same
muscular strength a fortnight after childbirth as she had
during pregnancy; and that, consequently, spirometry at
these times may not give results sufficiently trustworthy for
comparison. There can be no doubt, however, that the
diminution in the respiratory capacity during pregnancy is
nothing like so great as might have been expected; and
that, therefore, as an explanation of the ameliorating effect
of pregnancy on phthisis, this local theory has not the
importance which it might otherwise have had. It is
nevertheless valuable, and the more so from the fact that
during pregnancy the daily excretion of CO_2 is increased, as
this will intensify the effects of any diminution in the breath-
ing surface.

According to the second theory, this mitigating influence
is the result of certain changes in the system which pregnancy
induces. These changes are numerous and important. We
know, for example, that the blood is markedly altered in
composition, being more watery, and having its corpuscular
elements so altered as regards number as to present a relative
increase in the proportion of white corpuscles. The heart is
enlarged, the left ventricle seems to be specially hypertro-
phied, and the arterial tension seems to be increased.† Tro-
phic changes occur in parts remote from the generative

* For these see "Monatsschrift für Geburtskunde," Bd. xxxviii. 1866, p. 457.
† See Angus Macdonald, "Heart Disease during Pregnancy," pp. 6 to 23.

organs ; *e.g.*, the mammary glands enlarge, and this even in absence of direct nervous connection ; as may be seen in an animal in which pregnancy has been induced after division of the spinal cord in the dorsal region. Hence we may suppose that the trophic processes in the lungs may be in some way influenced.

Knowing also that pregnancy has been looked upon as tending to affect the kidneys as injuriously as it does the lungs beneficially, and presuming that the view which supposes that this is due to some cause other than the pressure of the uterus on the renal veins, is the correct one, we might further suppose that, owing to the functional connection between lungs and kidney, any condition which affects in the way of rendering more difficult the function of the one will exercise a stimulating effect on the other.

Lastly, we have to remember that just as Pollock says of tubercle, "every agent capable of converting it from its course adds prolongation to its time,"* the beneficial effects of pregnancy in phthisis may be likened to those produced by counter-irritation. Pregnancy may therefore mitigate the pulmonary symptoms in the same fashion as does a blister, seton, or even the occurrence of a complication such as ulcerated intestine, or fistula.

Parturition is an act which is always accompanied by danger, and although the phthisical condition seems frequently to render its performance more rapid and less exhausting, yet the risk of hæmorrhage, the occurrence of a certain amount of fever, and the fact that it, along with uterine involution, necessitates sudden and important changes in the amount and composition of the blood, and in the functions of the excreting organs, seems to render its performance in this disease more than usually hazardous. Moreover, there is reason to believe that the condition of the generative passages in the post-partum state may lead, in

* Pollock, "Elements of Prognosis in Consumption," p. 388.

tubercular cases, to the development there of tubercular granulations, and so add to the exhaustion of the patient.*

It is important to observe that, as stated by Pollock,† it is rare for a pregnant phthisical patient to die undelivered. Even in very acute cases, life is usually prolonged until labour has occurred. Lactation is invariably to be prohibited in the phthisical, as dangerous alike to mother and child.

The question of marriage for consumptive individuals is one which frequently presents itself, and although (perhaps fortunately) medical is as little likely to be followed as any other advice in this matter, its importance generally is immense. It has two aspects, a social and an individual one.

From the first of these points of view, all observations indicate the injury done thereby. The constitutional debility will certainly be transmitted; and it is well known that cases hereditarily phthisical present an earlier development and a more rapid course than others. In this aspect, therefore, the question of marriage is to be strongly negatived.

From the individual point of view, however, the question may be answered differently. Phthisis is an affection in which remissions of symptoms are apt to occur; and inasmuch as these afford valuable opportunities for treatment, their occurrence should be favoured by every means in our power. We have also to remember that the progress of this, as of other diseases, is often powerfully affected by the mental condition, *spes phthisica* notwithstanding. Any depressing emotion, therefore, such as would be entailed by actually opposing the idea of marriage, is almost certain to minimise the good obtained from these remissions. Again, the possibly beneficial influence of pregnancy is to be considered; and although this may be counter-balanced by the perils incident to delivery and lactation, yet these dangers may be greatly diminished, and in comfortable circumstances,

* Walshe, *ibid.*, p. 445. † *Ibid.*, p. 299.

and in cases where the amount of lung substance destroyed is so limited that the cicatricial contractions can be compensated for by emphysema of the surrounding lung tissue, the results may be on the whole favourable.

Whilst admitting this, however, under no pretext, as before stated, should lactation be permitted. No doubt, as Ruehle * says, a woman in such circumstances may be induced to take and assimilate a very large quantity of food, and benefit herself for the time as the result of the laudable desire to benefit her child. The risk, however, of ultimate evil results to both more than counterbalances the benefit to be obtained thereby.

Menstruation in the prephthisical stage may be fairly normal ; but, as in any other debilitated condition, it is often deficient. In confirmed phthisis its presence seems to depend on whether or not there is accompanying fever. If this exists, *i.e.*, if the disease is progressing, menstruation is absent ; and, as is well known, its reappearance is looked upon usually as denoting to a greater or less extent an abatement of the mischief. When in slow, chronic cases menstruation is regular, the symptoms are frequently aggravated at the periods ; † and it is interesting to note that something similar to this occurs in other diseases. For example, a corresponding aggravation has been observed in insanity.‡ Associated with this it is, however, noteworthy to remark, that in the acute continued fevers—typhus, relapsing, typhoid, and scarlet—menstruation usually occurs, and is frequently profuse. Fever, therefore, in itself can hardly be looked upon as the cause leading to its absence in phthisis. I am indebted to Dr Wood, of the Edinburgh Fever Hospital, for drawing my attention to the observation, that relapses in typhoid fever are frequently to be associated with menstruation. For instance, he informs me

* Ziemssen's "Cyclopædia," vol. v., p. 494.

† Daremberg Lyon Medical, 1882, No. 4, and Centralbl. für Gynækologie, 1882.

‡ Clouston, *ibid.*, p. 474.

that if menstruation occurs within two or three days after the end of the third week, a relapse is very likely to take place ; and I have had the opportunity of making similar observations in erysipelas. In the erysipelas ward of the Royal Infirmary, I had under my care a young woman who developed ten successive attacks of erysipelas in as many months. Each attack left a slight glandular swelling in the right submaxillary and parotid regions ; and it was observed that two or three days before a menstrual period these became slightly more enlarged and rather painful, after which a relapse of erysipelas occurred. My idea of the explanation of such cases is, that corresponding with each premenstrual period there is increased tissue metamorphosis, scarcely amounting, as a rule, to fever, but leading to increased resorption. Any morbid material which may at the time be in the organism—as, for example, the typhoid germs in the intestine, or the erysipelas germ in the enlarged glands—will then stand a better chance of being taken up again by the organism. The application of such considerations to menstruation, when it appears during chronic phthisis, is obvious. Not only is it likely to aggravate the general symptoms, but we may suppose that at the periods the chance of resorption and consequent fever will be increased.

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CHAPTER II.

ETIOLOGY OF PHTHISIS—*Continued.*

As has been stated, the mortality from phthisis may be regarded as one of the sacrifices which nature demands from humanity in return for her good efforts to transform the struggle for existence from the physical to the intellectual, that is to say, in return for the advantages of a progressive civilisation. This is indeed obvious. In savage or nomad life the physical is the element in man which is mainly developed, and although, in such circumstances, struggles have to be engaged in and sacrifices are entailed, he enjoys there an amount of breathing space, a freedom of movement, and an exposure to sun and air, which, by promoting healthy lung function in a healthy surrounding, renders chronic disease of that organ little liable to occur.

Civilisation, however, inasmuch as it is only possible when numbers of individuals are brought together, alters this, and all statistics and observations demonstrate that where the population is most dense, and where, therefore, individual movement is most limited, and air least pure, phthisis is most prevalent. Naturally such a statement as this, as regards phthisis, is only a general one, and is subject to many qualifications, but its truth is distinctly borne out on comparing the amount of this disease in urban and rural districts, and in countries in which the inhabitants are nomadic pastoral or agricultural, and industrial.

Among industries, some are, of course, more hurtful than others, and the evil effects are brought about in a variety of

ways. That deficient physical work is one of these, is shown by the number of engravers, watchmakers, compositors, clerks, tailors, &c., who become phthisical, and although in such industries the impure heated air with which they are usually associated must aid in the development of the phthisical process, yet the lessened respiratory function which such occupations entail must have a very important effect. Thus Dr Guy * showed that in the London printing establishments, of compositors and pressmen, the former were more prone to consumption, and he attributed it to the fact that although both worked in the same heated impure atmosphere, the former had little physical work, whilst the latter had every now and then to perform work requiring a great amount of physical exertion.

Breathing an atmosphere in which dust particles are suspended is well known to be an important factor in the causation of lung disease, and specially of phthisis, and the amount of noxiousness seems to depend on the quality, as well as, or probably more than, on the quantity of the dust inhaled. Thus the dust of coal, wood, or flour seems to be less injurious than that given off by textile fabrics, as in cotton or wool factories, whilst these latter are exceeded, as regards injurious effects, by the metallic and mineral dust. In evidence of this Dr Ogle † gives the following as the order of mortality from consumption and respiratory diseases among individuals whose occupations entail dust inhalation : --1. Coal-miners ; 2. Carpenters and joiners ; 3. Bakers and confectioners ; 4. Masons, builders, bricklayers ; 5. Wool manufacturers ; 6. Cotton manufacturers ; 7. Quarrymen ; 8. Cutlers ; 9. File makers ; 10. Earthenware manufacturers ; 11. Cornish miners. That particles of metal or stone, when inhaled, should prove more irritating than those of flour or

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* " Influence of Employments on Health and Disease," *Statistical Society's Journal*, vol. vi., 1843, p. 204.

† Supplement to the 45th Annual Report of the Registrar-General

wood can be readily understood, but there is no doubt (as Dr Ogle has pointed out), that in drawing conclusions as to the relative injuriousness of the different kinds of dust from a table such as this, great care must be exercised. For example, the mortality from consumption among coal-miners is on the whole so low, and compares so favourably with that of many occupations in which there is no dust inhalation, that in the opinion of some observers coal dust is not only not a provocative of consumption, but, indeed, acts as a preservative from this form of disease.* Again, the liability of bakers to consumption has certainly other causes than flour dust inhalation. The heated and moist atmosphere in which they work, and the sudden changes of temperature to which they are exposed, probably act in this manner much more potently, and this is borne out by the fact that millers who, as far as dust is concerned, breathe a similar atmosphere, are, as a rule, comparatively free from phthisis, and healthy.

Further, the liability to this disease from which masons, carpenters, joiners, and others, suffer must also be looked upon as being not altogether due to dust. Their work, carried on in sheds or in houses unprovided with doors or windows, entails constant exposure to cold and draughts. For the last few years I have made a habit of asking such, whenever they come to me as patients, to what they attribute their illness, and I have observed that, although they all understand the injury which dust is apt to produce, they almost invariably ascribe to the cold draughts the greater share in the production of their complaint. What proportion each of these different morbid agencies has, it is of course impossible to form any very definite idea ; but with a view to elicit some information on this point, I have drawn up a table to represent the relative liability of individuals of different occupations to consumption and certain other diseases. The occupations

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* Walshe, "Diseases of the Lungs," 4th edition, p. 226. Compare also Niemeyer, " Practice of Medicine," vol. i., p. 197.

which I have selected are coal-miners, printers, carpenters, farmers, masons, tailors, bakers, butchers, and cab and omnibus drivers. I have chosen these as representing occupations some of which are regarded as affording a special immunity from this disease, as farmers and farm labourers ; others a special liability to it, as masons and printers ; and others again, the effects of which on it are somewhat doubtful, as butchers and cab-drivers.

This table has been drawn up from the data given in Dr Ogle's report (Table L, p. 32).

COMPARATIVE MORTALITY OF MALES, 25 TO 65 YEARS OF AGE, IN (SELECTED) DIFFERENT INDUSTRIES FROM (SELECTED) DIFFERENT CAUSES.

	Diseases of the Nervous System.	Diseases of the Circulatory System.	Phthisis.	Diseases of the Respiratory System.	Diseases of the Urinary System.	Liver Diseases	Alcoholism.	Gout.
Farmer, Grazier.	67	70	46	55	75	105	60	66
Cab - Omnibus-Service	112	133	163	187	158	138	330	366
Butcher............	116	110	118	114	134	246	230	166
Baker	114	109	96	102	97	117	150	166
Tailor..............	121	105	129	102	109	123	110	133
Printer............	75	77	209	91	73	70	30	1...
Mason, &c........	73	95	114	110	119	76	50	oo
Coal-miner.......	77	77	75	78	86	91	30	...
Carpenter, &c...	74	86	92	73	95	92	40	66

MORTALITY FROM PHTHISIS RELATIVE TO MORTALITY FROM OTHER CAUSES MENTIONED IN ABOVE TABLE (GOUT EXCEPTED).

Farmer, Grazier,	.	.	1 : 9·39	Tailor,	.	.	.	.	1 : 5·19
Cab-Omnibus-Service,	.	.	1 : 6·49	Printer,	.	.	.	.	1 : 1·99
Butcher, .	.	.	.	1 : 8·05	Mason, &c.,	.	.	.	1 : 4·58
Baker,	.	.	.	1 : 7·17	Carpenter, &c.,	.	.	.	1 : 5·00

Looking only at the amount of phthisis in men following these occupations, the list in order of liability runs thus— printers, cab and omnibus drivers, tailors, butchers, masons, bakers, carpenters, coal-miners, farmers and farm labourers.

tion of bursæ to extend the dimensions of its synovial
territory.

For convenience, the origin of the various structures of
the knee-joint are arranged in a tabular form :—

Lateral Ligaments.

Internal   .   .   .   Tendon of the adductor magnus muscle.

External   .   .   .   Tendon of the peroneus longus.

Fibro-Cartilages.

Internal—External   . { Modifications of the femoro-caudal, biceps and semi-membranous muscles.

Crucials.

Anterior and Posterior { There are no certain facts as to which muscles they originally belonged.

Synovial Membrane.

The great cul-de-sac . { Original bursa between the quadriceps extensor and the femur.

Middle portion .   .   The original patellar bursa.

Lig. mucosum and { The remains of the sac-wall of the patellar alaria   .   .   . { bursa.

CHAPTER VI.

THE ANTERIOR ANNULAR LIGAMENTS OF THE ANKLE.

THE structures included under the above title are two in number, one is placed at the lower end of the leg, and is simply a transverse band of fibrous tissue passing from the tibia to the fibula and serving to retain the vertical portion of the extensor tendons. Although it is a structure very general, from amphibians to man, it has apparently no morphological significance. The other ligament arranged
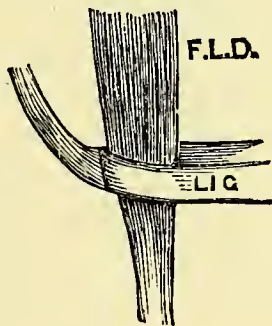

FIG. 10.—The inferior anterior annular ligament of the ankle joint of a monkey. F.L.D., extensor longus digitorum muscle.

in the form of a loop, is attached to the calcaneum at the outer end of the deep groove which lodges the interosseous ligament; the contiguous fibres of these two ligaments blend. The loop of this ligament is traversed by the tendons of the extensor longus digitorum and peroneus tertius muscles. From the inner limb of the pulley a fibrous cord passes beneath the extensor proprius hallucis and tibialis anticus muscles to be attached to the internal malleolus.

By studying the relations of this structure in a large number of mammalian forms, it turns out that the loop

antagonistic to phthisis than is apoplexy, whilst as against there being anything like a distinction in the diathetic conditions, it has been shown that carefully investigated cases of cancer show a strong phthisical tendency in the family history, and *vice versa*.*

But these diseases may be compared in other respects. As regards sex, for example, an agreement is found, both occurring most commonly in females. This is shown by the curve, which represents the proportionate male and female mortality from cancer in Scotland during the ten years 1870 to 1879.†
A further point is that the maximum is reached earlier in women (fifty-five years) than in men (sixty-five years).

But on comparing the relative mortality of the sexes from this disease at different ages, a remarkable difference is found, for the proportion of women who die of cancer in early years (under twenty-five) is *less*, whilst in old age it is *greater* than that of men,—a condition of matters the reverse of that which, as we have seen, exists in phthisis.

The fact that the cancer mortality, like that of phthisis, reaches its maximum earlier in woman, might be explained by her period of growth, as distinguished from maturity and development, being shorter than that of man, but it is peculiar that up to the twenty-fifth year, or thereabouts, female cancer should be less common than male, whilst female phthisis is, as we have seen, more common. Associated with the fact that women are longer lived than men, and that in old age female cancer seems commoner than male, it might denote that although these diseases agree in indicating a defective constitution, they are yet essentially different; that whilst phthisis is largely the result of the effects on the organism of

* Weeden Cooke, *Medical Times*, 1867, i., p. 538; Cahen, "Centralblatt für klinische Medicin," 1885, p. 860; and Lebert, "Klinik der Brustkrankheiten," Band ii., p. 4.

† The relative liability of the sexes to cancer could of course have been more exactly compared had it been possible to exclude cancer of the reproductive system.
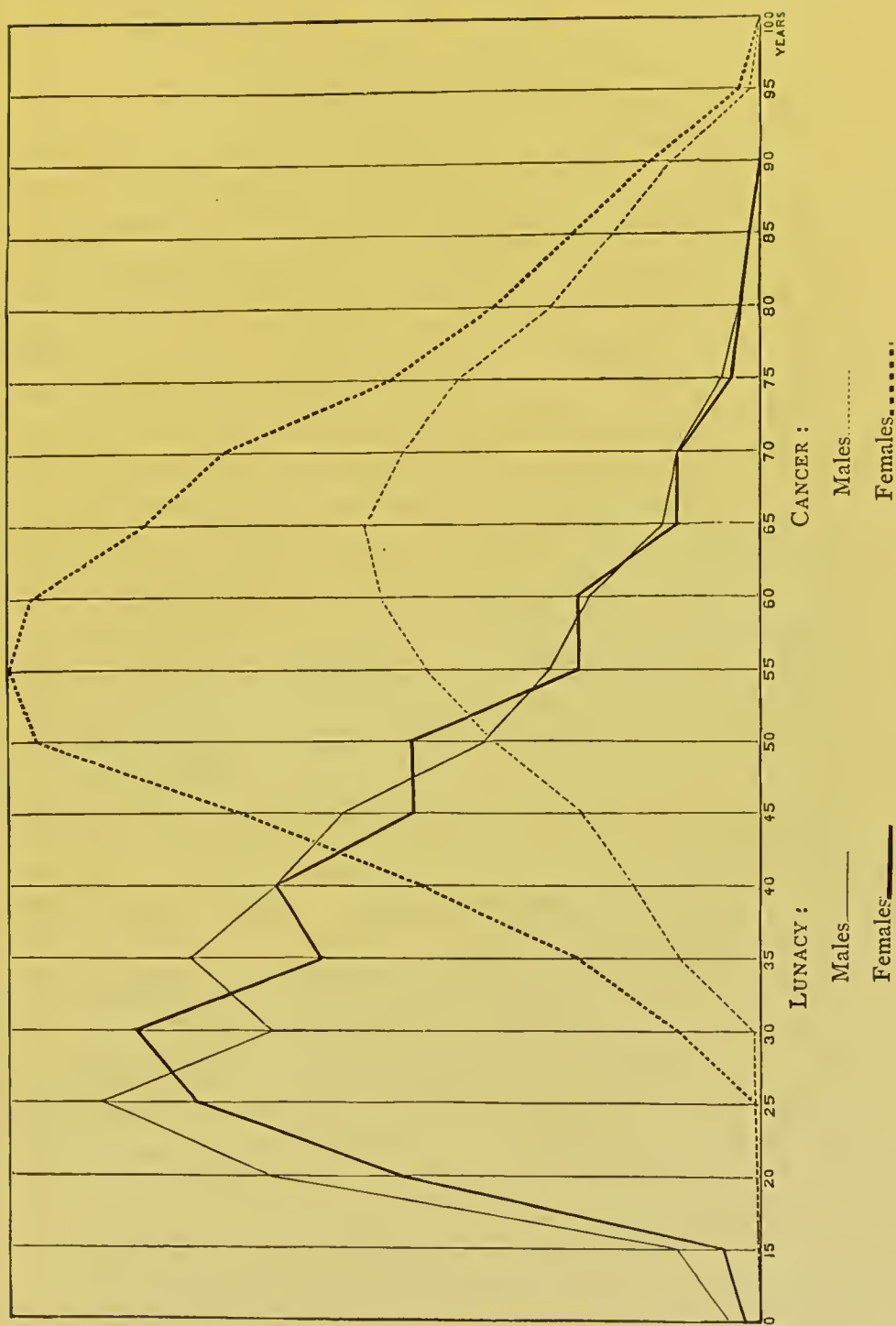
unfavourable surroundings, cancer is to be regarded more as a sign of degeneration or senility, abnormal, mainly because occurring at too early an age.

The close association of phthisis with insanity as an item in the family history, and as a disease which is specially prevalent in asylums, has been acknowledged, and the importance of trusting to physical signs rather than symptoms in connection with the diagnosis of phthisis in the insane has often been adverted to.

Phthisis and lunacy seem to agree in both being most frequent in females, and the form of insanity which as regards age most closely corresponds with phthisis is mania,* as distinguished from melancholia and general paralysis.

We find differences, however, when next we compare the relative ages at which insanity affects the sexes. Thus the curve † seems to show that in the early years it is most frequent in males, reaching its maximum at twenty-five; less frequent in females, reaching its maximum at thirty; and that in later life the liability is almost equal. Here, then, we have with insanity, as with cancer, a condition different from that which obtains with phthisis. That both of these show in early life a greater tendency to affect males stands out strikingly. It is to be noted, however, that insanity differs from cancer in having its maximum later in females.

The association of phthisis or the phthisical tendency with insanity in the same individual next deserves attention. A phthisical insanity, *i.e.* an insanity occurring in individuals in whom there is a strong tendency to phthisis, is recognised. It is of the "mildly delusional, slightly demented type," ‡ and

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* Clouston, " Mental Diseases," p. 206.

† This curve is constructed from 1785 male and 2200 female cases admitted into Morningside Asylum. For these data I desire to express my thanks to Dr Clouston.

‡ Clouston, *ibid.*, p. 461.

moodiness, suspicion, and melancholy seem to be its most usual characteristics ; and the importance of these mental conditions, as associated with phthisical insanity, is strengthened by the observation,* that they are likely to be induced when in a case of previously existing insanity phthisis supervenes. Riva and Suphide † also state that phthisis is more common in cases of depression and of mental decay than in the insanity of an exalted kind, and they point out also that no "metastasis" of any kind occurs, *i.e.* that where phthisis supervenes on insanity, or insanity on phthisis, nothing like an amelioration in the symptoms of the primary affection can be detected.

It may be here remarked that such a mental condition is different from that with which medical men are often familiar in ordinary cases of phthisis, where the mental faculties are not unlikely to evince an increased acuteness in the reasoning power and imagination, or, at least, a mental condition (spes phthisica), the opposite of that of suspicion and melancholy. The contradiction here, however, disappears, if we associate the spes phthisica with cases in which increased tissue metabolism is distinctly present. The cerebral and bodily conditions which constitute mental exaltation,‡ as distinguished from depression, are then existent, and practically it will, I think, be admitted that of the different types of phthisis (see Chap. V.) the spes phthisica is most likely to be associated with the chronic pneumonic, and least with the chronic tubercular. In both of these fever will of course be met with, but whilst in the former inflammatory action takes a specially prominent place, in the latter tubercular deposition seems to constitute the main lesion.

As further of interest in connection with this question, it

* Clouston, "Mental Diseases," p. 472.

† "Phthisical Diseases in the Insane," Riva and Suphide. See reference in *London Medical Record*, 1879, p. 479.

‡ Clouston, *ibid.*, p. 232.

would seem that in phthisical disease the "quality" of the nutrition, if we may use the term, is good. Although there is rapid wasting, yet, as was pointed out long ago by Lænnec, there is but slight tendency to septic decomposition and bed sores, and the bodies of phthisical patients are after death slow in running into putrefaction.*

Hysteria is an affection which by Walshe and others has been regarded as antagonistic to phthisis, and certainly an apparently harassing cough, with frequent shallow breathing, loss of flesh, sweating, and suspicious apex signs, is often met with in hysterical women without any real lung mischief. Such cases, however, not seldom become distinctly phthisical later on, and whether the hysteria has been brought about by the prephthisical debility, or the unhealthy indoor or inbed hysterical life has caused the phthisis, is often a difficult matter for the physican subsequently to decide upon.

Rheumatism and gout have also been considered in con- nection with phthisis, but inasmuch as the diathetic conditions on which the manifestation of these diseases depends often lead to organic cardiac, vascular, or renal disease, we must bear in mind that their effects in this double relation have to be distinguished. That is to say, we have to answer the question as to the effects on phthisis,—first, of the rheumatic or gouty diatheses ; and secondly, of their complications, as cardiac, vascular, and renal disease. The first need only be answered at present.

Rheumatism has been shown to be closely associated with phthisis, either as preceding this disease or as attacking in- dividuals during its course.† In the phthisical, further, a tendency to rheumatism in the family history is very frequent. It is to be noted, however, that when a rheumatic attack develops during phthisis it is not usually severe, and like all

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* Lænnec, " Diseases of the Chest," p. 270.

† Pollock, *ibid.*, p. 270. See also Austin, *Lancet*, 1883, p. 10, for cases in which these diseases were associated.

other complications, it seems, at least, frequently to diminish the acuteness of the lung mischief. In such cases, however, or conversely where phthisis succeeds acute rheumatic attacks, although the disease may be chronic, the patient's condition is one of marked feebleness. The gouty habit is by some believed to act as unfavourably as regards phthisis as rheumatism,* by others it has been regarded as more or less antagonistic.† In favour of this latter view is the frequent association of gout with adipose tissue, phthisis being not so common in individuals having a tendency to corpulence.‡

The connection of syphilis with phthisis has received a great deal of attention, and there can be no doubt that in association with the etiology of this disease it occupies a very prominent place. In individuals who are syphilitic by heredity, phthisis is common, as indeed it is among all who succeed to any vitiated constitutional state. There can be no doubt also, that those who have acquired that disease frequently become phthisical, when in the absence of syphilis they would probably have escaped. It has been said, however, that pulmonary phthisis is rare in the acquired as compared with the inherited form of that disease. As to why syphilis predisposes to phthisis little need be said. We have only to remember the impaired constitutional vitality which it necessitates, and the fact that at any rate in the acquired form it is frequently associated with bronchial catarrh.

In this connection we have also to remember that true syphilitic disease of the lung and respiratory passages occurs, as distinguished from the phthisical process. This is most frequent in the acquired form, but from the fact that it has been found in the fœtus, it may be concluded that it also can occur hereditarily.

Chronic alcoholism is a condition, the influence of which on

* Pollock, *ibid.*, p. 273.   † Walshe, *ibid.*, p. 450.
‡ Ebstein on Corpulence, p. 12

phthisis has excited great difference of opinion, being re-
garded by some as antagonistic, by others as predisposing.
In favour of the former view the fact that alcohol tends to
produce an over-growth of fibrous tissue or sclerosis might
be brought forward, and on this theory its use has been
advocated in the treatment of phthisis, in the hope that en-
capsulation of tubercular deposits or cicatrization of cavities
may be induced.*

Other observers have, as might have been expected, come to
the conclusion that alcoholism predisposes to phthisis.   Thus
Richardson † has described an alcoholic phthisis, and the
elaborate statistics brought forward by Dr Ogle show that the
mortality from this disease is high among those whose
occupations, &c., imply temptation to over-indulgence in this
respect.   It must be remembered, however, that although
such is the case, the relative mortality in these classes
from phthisis may be low, and of this the case of the
butchers and cabdrivers may be an example.   In these
the effects of alcoholism are marked, and the death-rate
from phthisis is high, but, as is shown at page 37, the
mortality from phthisis relative to the mortality from other
causes is low.

That habitual over-indulgence in alcohol, by leading to im-
paired nutrition, by inducing catarrh, and by increasing the
risks of exposure, should often lead to the development of
consumption, all must admit, but that alcohol *per se* acts in
this manner is a conclusion which the statistics above re-
ferred to hardly warrant us to arrive at.

As regards ague and its connection with phthisis, a great
diversity of opinion exists.   In favour of there being an
antagonism there is a host of names—Wells, Boudin, Graves,
Copland, Walshe, Pollock, &c.—and according to these observers
this antagonism acts in protecting a phthisical case from

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* Jaccoud, " Phthisie Pulmonaire," p. 192.
    Ward Richardson, " Cantor Lectures on Alcohol," 1875, p. 103.

malaria, as well as in guarding a malarious one from phthisis. As to how this influence is brought about, theories are not wanting. Some suppose it to be through the general effects of the malarial poison upon the blood, so modifying assimilation, &c., that the "intrinsic vice of nutrition essential to phthisis shall cease to be a possible existence." By others it has been ascribed to the enlarged spleen mechanically interfering with respiration ; whilst a third supposition might be that it was due to the coincident and subsequent anæmia. Unfortunately, however, for the theory of antagonism in general, Hirsch * has shown that in the Netherlands, some districts of France, Alsace, Oldenburg, Hungary, South Russia, and Algiers, both phthisis and malaria abound, and in discussing the subject he further suggests that the observation, that with the disappearance of malaria in a district there is the appearance of phthisis, can be accounted for as being due, not to the elimination of the fever poison from that district, but to the increase in the density of the population which immediately ensues.† In face of such contradictory statements it is a difficult matter to draw any conclusions, but, as with other matters of dispute, it seems not impossible that an agreement may be arrived at by a compromise, *i.e.*, by admitting that although no general antagonism may exist between these diseases, yet that the effects of the malaria, enlarged spleen, or anæmia, may render phthisis less likely to supervene. The view held by Gowan,‡ as the result of his observations of these affections in Siam, is that the enlarged spleen interfering with lung function is the main cause, and in favour of this view he states that he has never seen a case of enlarged spleen and consumption coexisting in which the right lung was not the first to be attacked.

* " Geographical Pathology," vol. ii., p. 99.
† Compare Vista, *London Medical Record*, 1883, p. 140.
‡ Gowan, " Consumption," London, 1878, p. 57.

How phthisis may be affected by the enlarged spleen will be discussed by and bye. Appropriately, however, for consideration comes now the subject of anæmia. Anæmia is an affection which might reasonably enough be regarded as provocative of phthisis. Caused essentially by more or less prolonged deprivation of fresh air and sunlight, and by improper food, and often associated with deficient physical exercise, it would seem peculiarly likely to induce in the lungs that functional impairment which leads to the development of consumption. As to its connection with that disease, however, there is perhaps no subject in the practice of medicine upon which a more complete difference of opinion seems to have existed, and to exist. By some it is considered as strongly predisposing as by others antagonistic. So strenuously has this latter opinion been held, that, as is well known, Trousseau prohibited the use of iron in all cases of anæmia in which a hereditary tendency to phthisis existed. There are probably few physicians who would carry their views this length, but that a certain antagonism exists between them many will perhaps admit. In favour of such an opinion we have to remember that although the bodily and mental processes in anæmia act feebly, there is comparatively little interference with the vegetative functions, the typically chlorotic being well provided with fat. Further, the dyspnœa which, as the result of deficient hæmoglobin, such patients complain of, must entail increased activity in the lung functions, while the pulmonary congestion and the fact that the blood is more watery than usual, will produce mechanically an excess of water in the lung tissue,—an effect which by many observers is considered to interfere with the process (caseation) on which the development of phthisis is deemed primarily to depend.

The fact, further, that with similarly unfavourable surroundings,—deficient light, air, food, and exercise,—one set of cases develops anæmia and another phthisis, seems in itself to

denote important constitutional differences, and this opinion has recommended itself to me from the observation, that cases suffering from repeated attacks of anæmia are in time more apt to evidence symptoms of rheumatic or organic cardiac disease than of phthisis. That a family history of phthisis should prevent a physician from treating anæmia is, of course, not to be thought of, but the consideration that these affections are brought on by similarly unfavourable surroundings, and that the latter affection may be to a certain extent protective, warrants us in assuming that we have in anæmia a manifestation of symptoms which we should carefully endeavour to interpret before essaying to remedy. In the treatment of anæmia the bare administration of iron or arsenic is by no means all that is indicated, fresh air and sunlight are specially required.

The exanthemata may exercise an influence on phthisis in two ways—first, by the bronchial catarrh with which they are all accompanied ; and, secondly, by the debility which they cause, and which lasts after they themselves have passed away. Their effects for evil are, however, not all alike. Typhoid fever is, for example, much more dangerous in this respect than typhus, in explanation of which we have only to remember, first, the greater tendency to bronchitis and pulmonary collapse which occurs in it ; secondly, the possibility of absorption of caseous matter from the intestines ; and thirdly, the fact that its longer duration and not infrequent relapses will produce in time extreme nervous and muscular debility. The extent to which this may reach I have been made conscious of by studying the condition of the muscles in debilitated states of the system. As every one engaged in the physical examination of chests will have observed, there occurs on tapping a muscle—for example, the pectoralis major —in emaciated and weakly individuals a fibrillar contraction and an idiomuscular wave. But occasionally there will be seen running along the muscle from each side of the idio-

muscular bulging a small wave, which I do not remember to have seen described clinically.*   It originates, as it were, in the stationary idiomuscular bulging, and travels from it towards either end of the muscle at the rate of about one inch per second ; and if the muscle be tapped at two points in the same longitudinal line, two waves can be made to cross without interfering with one another's progress.   Further, in cases where, as the result of improved nutrition, the gradual disappearance of this wave can be observed, no change in its rate of progress will be detected.   This wave is seen occasionally in phthisis ; but the best examples of it which I have as yet met with were in protracted cases of typhoid fever. Its occurrence, therefore, in these circumstances, denoting great nervous and muscular debility, is important in connection with the association of this disease with phthisis, and I would here suggest its possible connection with those structural changes which Frænkel and Posadsky have described as occurring in the muscles of the larynx, trunk, and limbs in phthisis.†   As might be expected in things medical, there are, on the other hand, not wanting observers who consider that not only is there no causal connection between typhoid fever and phthisis such as above described, but that something of the nature of an antagonism exists between them.   Among such are Rokitansky, Rilliet and Barthez, Cless, Griesinger, Germain Sée, but there are, I think, few physicians in this country who share this opinion.‡

The occurrence of consumption as a sequel to measles is also acknowledged, and according to Copland this is specially apt to occur in the case of individuals about or above the age of puberty.   Here, again, the explanation is probably found

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* By physiologists a wave analogous to this has been described as occurring in muscles after removal from the body (Schiff, *Physiologie der Menschen*, i. p. 26).

† *Lancet*, 1881, p. 148.

‡ Compare Burkart—Ueber miliartuberculose und über das verhaltniss der Tuberculose ueberhaupt zum abdominal typhus.—*Deutsches Archiv für klinische Medicin*, Band xii., p. 277.

in the bronchitis and catarrhal pneumonia so apt to occur, and, as Ruehle mentions, in the infiltration and caseation of the bronchial lymphatic glands induced thereby.

The connection of scarlatina with phthisis seems to have nothing worthy of remark; and as for smallpox, there is an opinion that it is not only not so likely to be followed by phthisis, but that having occurred it may even diminish the tendency to this disease. Thus, Copland says, " I have long remarked, and believe that others have also remarked, the very rare occurrence of phthisis in any one even but slightly marked with smallpox." In practice one often meets exceptions to this, but I mention the opinion as interesting in connection with the relationship between skin affections and phthisis.

Skin disease in relation to phthisis, is a subject the investigation of which would seem to be of special interest when the allied functions of skin and lung is remembered. Little about this is known, but there is a consensus of opinion that the so-called diathetic affections, psoriasis, eczema, &c., are very unusual associates of phthisis, the explanation of which is probably the increased tendency to perspiration and the functional activity of glands, which this disease induces. Further, it is of interest to note that asthma has been observed by Sir Andrew Clark and others to be associated with skin affections in such a way as to indicate some relationship.

The parasitic and contagious variety of skin affections are, of course, found in consumption, and of these notably pityriasis versicolor, but whether the nature of the skin and sweat in consumption presents conditions peculiarly favourable for the implantation of the parasite, or only favours its development by precluding strict attention to cleanliness, is not clearly settled. It is certainly much more common among hospital or dispensary than among private patients.

Diabetes mellitus is well known to be closely associated

with phthisis. It occurs often as a forerunner, and as an item in the family history its importance is acknowledged.

Why the diabetics are specially liable to phthisis has been explained in various ways. By some it has been ascribed to their state of nutrition being much below par, by others to the probability of the trophic function in the lung being impaired owing to disturbance in the vagus innervation;* whilst a third view s that owing to dryness of the lung tissue the process of caseation will be favoured.

It is also noteworthy that, according to Leichtenstern† and others, the percentage amount of hæmoglobin in the blood in diabetes is occasionally quite up to, or even above the normal, owing probably to the relative deficiency of water. If anæmia, with its relative deficiency in hæmoglobin, tends to produce pulmonary congestion and consequent moisture, we might suppose that we have in this a further cause for the production of a dry state of the pulmonary tissue in diabetes. In whatever way produced, however, there can be no doubt that in diabetes tissue nutrition is peculiarly abnormal, simple pneumonias in such patients often terminating in gangrene.

As regards etiology, however, there are some important points of difference between it and phthisis. Thus it is more common in males than in females ; and further, although most frequent in early life, yet a large proportion of cases occur after the 45th year. (In the ten years (1870 to 1879) there occurred in Scotland 633 male and 412 female deaths from diabetes. Of the male deaths 56·25 per cent., and of the female 57·27 per cent., were before the age of 45.) Again, the corpulent frequently become diabetic. It is certain, however,

* Schou states that he has found in the alveolar and pleural exudation of vagus pneumonia a micro-organism which, when administered by tracheal injection or inhalation to a healthy animal, seems capable of inducing in it a similar inflammatory affection.—*Centralbl. für klinische Medicin*, Jan. 23, 1886.

† Untersuchungen über den Hæmoglobulingehalt des Blutes in gesunden und kranken Zuständen   Leipzig, 1878.

that in advanced life and in the corpulent the prognosis is always much more favourable.

Another condition which has been said to be an infrequent associate of, or indeed antagonistic to phthisis, is enlarged external lymphatic glands,* and when we remember that such glands are to be regarded as potential tubercular foci, such a statement seems somewhat remarkable. In connection with this, further, the infrequence of phthisis in individuals the subjects of open strumous sores has been noted. Pollock says, " It may begin before the glands are affected or after their cicatrization, but it is not often found to begin with their suppuration."

There can be no doubt, however, that there is here only the appearance of an antagonism. In the first place, the tendency to enlargement of the cervical glands in strumous individuals occurs at an earlier age than that of phthisis ; and, secondly, when phthisis does develop in an individual with such glands, these, if there be any fever, will be sure rapidly to diminish. Again, the fact of phthisis being uncommon in those suffering from suppurating glands, may (apart from any counter-irritating effects) be ascribed to the chances of resorption of tubercular matter being then reduced.

The bearing of these considerations on the treatment of glandular affections is obvious, but need not be discussed here. At present it is only necessary to notice that in connection with the etiology of phthisis, enlarged lymphatic glands are anything but antagonistic in the real sense of the word. They are not only the manifestations of the same constitutional weakness, but may act as foci for tubercular infection.

We now pass to the consideration of phthisis in connection with other affections of the lungs themselves, and, as might be expected, the information that meets us here is decidedly more definite. All observations agree in showing that whatever induces what has been termed *venosity* renders phthisis less

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* Walshe, *ibid.*, p. 435, and Pollock, *ibid.*, p. 90.

liable to occur, but whether this is the result of the increased respiratory function, the pulmonary congestion and consequent moisture of the lung tissue, or other causes, is of course not certain. The conditions which give rise to this venosity are manifold, and merit detailed consideration.

Organic disease of the heart is rare as an associate of phthisis, and when it does occur it seems to favour slow progress. The infrequency may be due to the fact, as stated by Walshe, that heart affections and phthisis are prone to occur at different periods of life, but that the venosity is really an important element in this antagonism is evidenced by the observation that mitral stenosis is the most, and aortic valvular affection the least rarely, a complication of consumption.[*] When we further reflect that the diathetic conditions in rheumatism and phthisis are closely allied, and that mitral disease is more associated with the early years of life than aortic, our opinion in this matter is strengthened.

It is to be remembered here that symptoms and signs of cardiac and vascular disturbance are common in phthisis, apart from organic disease, in the form of hæmic murmurs, and murmurs the result of a twist or kink, or dilatation of the large vascular trunks, produced by cicatricial contraction of an affected lung. Such conditions are usually, however, readily distinguished from organic disease.[†]

A reference must also be made to the co-existence of true aortic aneurism and phthisis. Aneurism, like most other cardiac or vascular lesions, tends in time to produce pulmonary congestion, and in this respect has been regarded as antagonistic, but by pressure of the sac on the lung a symptomological and pathological condition, identical with phthisis, is brought about, and for this, as Balfour[‡] notes, the patient often seeks relief unconscious of his real malady.

[*] Ruehle, Ziemssen's *Cyclopædia*, vol. v., p. 508.
[†] Brakenridge, *Lancet*, 1880, i. p. 80.
[‡] "Diseases of the Heart," 2nd edition, p. 380.

Along with organic cardiac or vascular disease are to be classed all congenital malformations, persistent ductus arteriosus, &c. These have been stated to be antagonistic to phthisis for reasons similar to those just given.

Malformations of the chest walls, the result of rickets, chicken-breast, spinal curvature, &c., are, according to most observers, rarely found in phthisis. This is, of course, to be ascribed to the consequent venosity, of the existence of which in severe cases the cyanotic complexion so frequently presented, and the liability to bronchial catarrh, from which such cases as frequently suffer, afford abundant evidence.

Abdominal affections, which impair the play of the respiratory apparatus, as ovarian cysts, for similar reasons are to be considered as antagonistic, and under this category comes also the enlarged spleen of ague. Pregnancy, as has been noticed,* does not diminish the respiratory capacity to anything like the extent which might have been supposed, still by many it has been considered to exercise a beneficial effect in this way.

A rather important and very interesting question as to the influence of a large waxy or fatty liver on the course or development of pulmonary phthisis comes up here for consideration. Seeing that, let us say, waxy disease and phthisis are found in similar constitutional states, and that in the latter affection the waxy liver is a not infrequent complication, can we say anything as regards its influencing the pulmonary condition, in a manner which theoretically we might suppose it to be capable of doing. There is no doubt that although the patient's general condition is worse after the development of the amyloid disease, yet the pulmonary symptoms often recede. How much of this is due to the mechanical effect of the large liver on the respiratory organs, and how much to the general effect of the complication,—hydræmia, dropsy, diarrhœa,—it is, however, impossible to say.

* See p. 29.

Lastly, we have to notice in connection with conditions producing venosity that Rokitansky says (p. 318), "Congenital smallness of the pleural sacs, paired with primitive smallness of the lungs, and, as it mostly is, with an inverse ratio of the development of the abdomen and its viscera, serves as a protection against tuberculosis." With this one has to remember the converse, viz.: that phthisis often occurs when the chest, as regards size, &c., is specially well developed, and when the respiratory capacity, as ascertained by the spirometer, is correspondingly great.

The connection of bronchitis with consumption has given rise to a great amount of discussion, and about it views of the most contradictory nature have been expressed. These we need not attempt to consider in detail; it is sufficient to mention that whilst some, as Louis and Laennec, have held that a bronchitis never leads to tubercle, others, as Graves and Niemeyer, assert that the direct opposite of this is much nearer the truth. With the latter most physicians will agree, but for the very decided opinion expressed by such as Louis and Laennec there is a certain foundation. In the first place, we must remember that phthisis may pass through its premonitory and first stages without cough as a marked symptom; and, further, that in comparatively advanced stages cough may be absent for days or weeks at a time. Secondly, the ages at which bronchitis is most frequent and apt to produce fatal results are different from those of phthisis, as the Registrar-General's return shows the mortality from the former is greatest during the very early and very late years of life. Thirdly, the tendency which long-standing bronchitis has to induce emphysema indicates an antagonism of a kind. Having said this, however, all that can be evidenced in the way of an antagonism has been said. A neglected bronchial catarrh is a very frequent cause of consumption, and it might not unreasonably be supposed that the infrequency of death from bronchitis in the adult, as

compared with the early and late years of life, which the
Registrar's returns show, is due to the possibility that, as the
result of the bronchitis, phthisis has then supervened, and
proved fatal. For similar reasons asthma and hooping cough
are apt to predispose to or terminate in phthisis, and in the
latter circumstances it is interesting to note that the con-
tinuation of the characteristic cough may for a time obscure
the diagnosis of the new malady. When, in consequence of
bronchitis, &c., emphysema has occurred, the tendency to
phthisis is of course diminished.

Pneumonia is a disease which, from the consideration of
its pathological condition, and the age at which it is most apt
to supervene, might readily be looked upon as closely allied
to phthisis. But by many, and more especially in Germany,
the very opposite of this is held to be the case. Thus
Heitler,* after discussing the possibility of a croupous pass-
ing into an interstitial pneumonia, says, " auf diese weise
enstand die lehre von dem ausgange der krouposen pneu-
monie ins kasige phthisie, eine lehre welche heutzutage kaum
mehr einen warmen vortheidiger finden will." Nevertheless
instances, real or supposed, of such a termination are often
published even in Germany,† and in this country a possible
connection between the two is by most physicians acknow-
ledged. Between them there are, however, essential differ-
ences.

Thus croupous pneumonia is very rarely followed im-
mediately by phthisis of the lungs ; in any case where it is
so, a strong predisposition must undoubtedly have existed. It
would seem, also, that if a pneumonia supervene in the course
of a phthisis, resolution may occur as readily as it does in a
healthy individual, and that no marked increase in the
severity of the phthisical process may follow.

Again, croupous pneumonia usually affects the lower lobes,

* Heitler, *Wiener medicinische Wochenschrift*, 1884, p. 1530.
† Schultz, *Deutsche medicinische Wochenschrift*, 1885.

and differs still further from phthisis, in that whilst the pneumonic process is usually limited by a lobe, the phthisical is usually not, but, as physical examination shows, extends from the apex downwards, often involving the middle lobe or upper part of the lower lobe posteriorly, before spreading to the whole of the upper lobe, the greater part of which is anterior.

. Further, the pneumonic process commonly affects lungs or portions of such already congested, as in heart disease, an occurrence the reverse of what we have seen to obtain in phthisis, and with this also, it is to be remembered, that in high altitudes where phthisis is rare pneumonia is common.

Thus, then, certain distinct differences between these diseases are met with. From a clinical point of view, however, there is no hard and fast line ; for an apex pneumonia, or one which, because occurring in a debilitated or cachectic individual, is catarrhal rather than croupous, may be the beginning of a phthisis. It would be interesting to know, in this connection, what percentage of cases of acute pneumonia leads directly or indirectly to such a termination. Such information cannot be easily obtained, but all observation seems to point to the rarity of this event. Out of 170 cases of phthisis, the histories of which I have had the opportunity of carefully investigating, I find that although in eighteen of them such a commencement was possible, in only three could it be said to have been at all probable. In two out of the eighteen there had been attacks of pneumonia years previously, from which, however, complete recovery had occurred.

Pleurisy seems to be very closely related to phthisis. It occurs frequently during its course, but what is of special importance in connection with its etiology is that it occurs with very great frequency in individuals who, weeks, months, or years afterwards, become phthisical. As was the case with

pneumonia, it is difficult to give with anything like accuracy the proportion of cases of pleurisy which end, directly or indirectly, in the development of phthisis : but of the 170 cases above referred to, in which the personal history had been carefully inquired into, certainly nine had suffered from and ascribed their illness to an attack of this disease. In several of these there had been repeated pleuritic attacks; in one the first had occurred thirty years before the onset of the phthisis ; in most, however, their occurrence had been from one to three years previously.

But now arises the question, In what way are these diseases associated, how is it that many individuals who have had pleurisy tend to become phthisical ?

In the first place, we must remember that the occurrence in an individual of one or several pleuritic attacks may be regarded as evidence, as strumous glands, catarrhs, &c., are, of a constitutional debility which in time will lead to the development of phthisis.

But, secondly, the connection may be more direct. A lung which, as the result of an incompletely absorbed pleuritic effusion, is semi-collapsed, or one which, with dilated bronchial tubes, is struggling to lessen the retraction which the chest parietes have to undergo as the result of a too long delayed absorption, is certainly not in a healthy state, and might, from the lessened movement, the tendency to bronchitis and retention of secretions,* be regarded as being in a fit state for the development within it of the phthisical process.

Thirdly, the air cells lying beneath the inflamed pleura may become involved by continuity, and the exudation into them becoming caseous may lead to phthisis.

Or, fourthly, the pleuritic effusion, in consequence of the process of absorption, for one or another reason, being incomplete, may undergo a similar caseous transformation, and

* Sir Andrew Clark, *Lancet*, 1885, p. 651.

cause phthisis by resorption of this caseous material, *i.e.*, by auto infection.*

In either of these ways, then, the connection of pleurisy with phthisis may be explained. As to which, however, obtains most frequently in practice there is much room for difference of opinion, the more so as in many cases of pleurisy, apparently followed by phthisis, the phthisis has really pre-existed.

Full information as to the part of the lung and the side affected in cases of phthisis which have previously suffered from pleurisy would be interesting. Such is, however, difficult to obtain, as patients' accounts of pleurisies which had occurred months or years previously are not of much value, and as it is so often impossible to make up our mind that the pleurisy has been the primary ailment, and not the result of tubercular extension from lung tissue. Of such cases, however, I have collected eight, in which the data are, I consider, trustworthy :—

1. M., æt. 43 ; pleurisy (with effusion) of left side, terminating in complete recovery, but followed two years afterwards by phthisis of right apex.

2. M., æt. 35 ; pleurisy (with effusion) of right side, terminating in complete recovery ; six years afterwards pleurisy of left side, terminating again in recovery, but after the lapse of another year followed by phthisis of left apex.

3. C., æt. 27 ; pleurisy (with effusion) of left side, terminating in recovery ; ten years afterwards phthisis of left apex.

4. L., æt. 23 ; pleurisy (with effusion) of right side ; recovery incomplete, and one year afterwards phthisis of right base.

5. W., æt. 32 ; pleurisy of left side, terminating in recovery ; three years afterwards phthisis of both apices, most advanced on left.

6. C., æt. 34 ; pleurisy, slight, of left side, and immediately

* Jaccoud, " Phthisie Pulmonaire," p. 81.

followed by marked pleuritic effusion on right; recovery, but four years afterwards phthisis of right apex.

7. H., æt. 25; pleurisy (with effusion) on right side; recovery; fifteen years afterwards phthisis of right apex.

8. F., æt. 40; pleurisy (with slight effusion) on left side, terminating in recovery; four years afterwards, phthisis of right apex.

These cases are numerically insufficient to afford us trustworthy data. It would seem, however, probable that the phthisis which follows a pleurisy which has been completely recovered from does not necessarily affect the lung of the corresponding side. Cases must, however, be judged individually.

CHAPTER III.*

ETIOLOGY OF PHTHISIS—*Continued.*

THE trachea, with its external fibrous layer of connective tissue, its cartilaginous rings, muscular fibres, and mucous membrane, divides and subdivides to form the bronchial tubes, the main distinctions between which and the trachea being, that as this subdivision goes on, the mucous membrane becomes thinner, the cartilages assume the form of irregular plates, and the muscular fibres become arranged in complete circles. In the small bronchi the cartilage has entirely disappeared, the circular muscular fibres are well marked, and the mucous membrane is much thinner, and lined by low columnar ciliated epithelium, showing here and there goblet-shaped cells.

After repeated subdivisions the smallest bronchi ('5–1 mm. in diameter) terminate in the bronchioles, and each bronchiole opens into several wider alveolar passages. Each alveolar passage is completely surrounded with air cells, and from it pass off also several similar but wider blind branches, the infundibula, which in their turn are beset on all sides with alveoli or air cells. Each bronchiole, with its alveolar passages, infundibula, and air vesicles, forms a lobule, of which the base is directed outwards, and of which the apex may be regarded as a terminal bronchus. The lung is thus made up of an immense number of these lobules, separated from each other by septa of connective tissue, the interlobular septa, which

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* The description in this chapter of the minute structure of the lung is largely taken from Landois & Stirling's Text-book of Physiology.

are connected on the one hand with the peribronchial, and on the other with the subpleural connective tissue.

The walls of the bronchioles show in the first place muscular fibres, which are continued along the alveolar passages, but not over nor between the air cells. Secondly, and outside these, elastic fibres, continuous on the one hand with those of the smaller bronchi, and on the other with those of the walls of the air cells. Thirdly, as regards the mucous membrane, a change is to be observed. Whilst the bronchioles themselves are lined with a single layer of ciliated epithelium, in the alveolar passages the epithelium is non-ciliated, low, and polyhedral. The air cells, arranged as we have seen around and in communication with the alveolar passages, have their walls formed of numerous fine elastic fibres, inside which is a nearly structureless membrane, composed of slightly fibrillated connective tissue, containing a few white corpuscles. Inside this again is the alveolar epithelium. This, for the most part, consists of clear polygonal squames, as shown by the silver process, but their shape will vary with the amount of distension of the air cells. They show also here and there germinating epithelium, and stomata or openings in the cement substance between adjacent cells. These stomata communicate with the lymph channels of the walls of the air cells, and their importance will be alluded to by and bye.

The blood vessels of the lung are derived from two sources, the pulmonary and the bronchial arteries. The pulmonary branches accompany the bronchial tubes, dividing and subdividing with them (their branches, however, never anastomosing), and ultimately terminate in small arterioles which supply several adjacent alveoli. In the alveolar walls these form a dense system of capillaries, being separated from the air in the air cells by the epithelial lining only. " Between two adjacent alveoli, there is only a single layer of capillaries, and on the boundary line between two air cells the course of the capillaries is twisted, thus projecting sometimes into one

alveolus and sometimes into the other. The veins corresponding to the arterioles usually arise at the opposite side of the air cells, they unite with others to form the pulmonary veins, and they seem to be joined in their course by a few small bronchial veins. The pulmonary veins seem to be *collectively narrower than the pulmonary artery* (water is lost in the lung), and they have no valves."

The bronchial vessels are the nutrient vessels of the lungs. "The arteries arise from the aorta or intercostal arteries, and accompany the bronchi without anastomosing with branches of the pulmonary artery. In their course they give branches to the lymphatic glands at the hilum of the lung, to the walls of the large blood vessels (vasa vasorum), the pulmonary pleura, bronchial walls, and the interlobular septa, and the blood is returned from those parts, principally by the bronchial veins, but in part also by the pulmonary veins through the anastomosis above mentioned."

The pleura pulmonalis consists, like all serous membranes, of a single layer of endothelium covering a thin layer of fibrous tissue. Under this layer again is the subserous areolar tissue, containing many elastic fibres, and continuous below with the fibrous tissue of the interlobular septa, which in its turn, as before mentioned, is continuous with the peribronchial connective tissue. The endothelium of the pulmonary pleura is flattened, and the amount of this flattening will vary with the distension of the lung, being most at the end of inspiration. In the cement substance between the cells stomata or openings into the lymphatics exist.

The lymphatics of the lung are exceedingly numerous, and have been described as being arranged in several systems. It is sufficient for our purpose, however, to remember that excessively fine lymph canals lie in the walls of the air cells, and that they communicate on the one hand, by stomata, with those air cells, and on the other with the larger lymphatics of the interlobular septa, and thus with the subpleural,

peribronchial, and perivascular lymphatic tissue. These minute
air cell wall lymphatics become injected when fine particles
(charcoal, cinnabar, &c.) are inspired or introduced into the
air cells artificially, and from there such particles find their
way into the perivascular, peribronchial, and specially into
the subpleural lymphatics, and thence finally into the bronchial
glands. The importance of this in connection with anthra-
cosis is obvious. Further, on the surface of the pulmonary
pleura, stomata are found communicating with these lymphatic
vessels, and through these fluid or minute solid particles
in the pleura can readily be absorbed.

The nerves of the lungs are derived from the anterior and
posterior pulmonary plexuses, and consist of fibres from the
vagus and sympathetic. They follow the distribution of the
bronchi, and terminate in part in the bronchial muscles, in
part in the blood vessels, and in part in the mucous mem-
brane. These nerves contain afferent and efferent fibres, the
action of the former being shown by the slowing of the
respiration which occurs on section of the vagus, and the
action of the latter by the contraction of the bronchial wall
which occurs on stimulation of that nerve. The existence of
sensory fibres in connection with the bronchial mucous mem-
brane is also important from the view which regards the
rapid breathing which is often observed in cases of pulmonary
tuberculosis as due, not so much to any real dyspnœa, as to
the irritation of the peripheral terminations of these nerves
by tubercles.[*]

So much for the lungs ; the chest walls now require consider-
ation. They are formed by the spinal column, ribs, and their
cartilages, the sternum, and soft parts, concerning all of which
it is only necessary for our purpose to remember, that they form
a somewhat unyielding case for the lungs, and that the amount
of resistance to yielding varies much at different points. (1.) It
is greatest about the four or five upper ribs, owing to the

* Ruehle, Ziemssen's Cyclopædia, vol. v., p. 622.

smaller circles which they enclose, and to the comparative shortness of the costal cartilages.   (2) It is less about the lower ribs, owing to their wider circles and longer cartilages. (3) A certain amount of yielding can take place above the first rib, as the chest wall there is composed of soft parts only, and it can also occur at the base of the lung owing to the flexible diaphragm.   (4) The mediastinum can yield towards one or other side to a considerable extent.

Having thus considered the structure of the parts concerned, their functions next require attention.

By the alternate dilatation and contraction of the chest, air is drawn into and driven out of the lungs, and in this way respiration is performed.   But it is here necessary to notice that this respiratory increase and diminution in the size of the lungs does not take place equally all over these organs. If a pleural window be made, that is to say, if a portion of skin, fascia, and intercostal muscle be removed, so that through the transparent costal pleura the lung can be seen, it will be observed that the amount of movement or gliding of the lung surface on the costal pleura is not the same all over. At the lower portion, and specially in the antero-lateral region, it is very considerable ; at the apices and posterior border above, it is very small, indeed, these parts of the lung might be said to be fixed points.   The importance of this difference in the amount of movement as regards the lung itself will be discussed shortly, its importance as regards the pleura has been pointed out by Rindfleisch in connection with the spread of the pleuritic process.

Let us now apply these theoretical considerations to the subject of phthisis, and remembering its frequency, its unfortunate tendency to progress, and the fact that certain parts of the lungs,—the apices,—are specially liable to it, let us see if from them some information of an explanatory nature can be derived.

In the first place, then, why should the lungs as such be

so liable to disease?   Here we have to remember that
functionally, the lungs are very active organs, and, as Graves
has noted, they are the only organs through which the entire
mass of the blood circulates.   They present to the air a secret-
ing surface of some 150 square inches, resorption from which
will probably occur more rapidly than from any other part of
the body.   They take in and give out some 25,000 times
each day about 20 or 30 cubic inches of air, the temperature
and degree of moisture of which must present great variations.
This air also is apt to contain solid particles, the expulsion
of which, and of any increased secretion which such irritants
occasion, is no easy matter from an anatomical point of
view.

Further, the degree of functional activity of the lungs varies
within extremely wide limits.   At one time, with ordinary
quiet sedentary breathing, only some 20 or 30 cubic inches
of air are displaced, and respiratory activity is going on in
the air cells about the lateral and lower portions of the lung
only ; at another, the quantity of air breathed is increased five
or ten fold, and the air cells of every part of the lung are
distended to their utmost.   Such variations too, it must be
remembered, do not concern the air cells alone ; the amount
of blood in the capillaries, and of secretion in the tubes, and
the activity of the lymphatic system, will each and all be
correspondingly affected.

Secondly, how is it that phthisis should be so progressive ?
why should the healing process be so difficult of attainment,
and why should a tendency to extension of disease be so
manifest ?   The healing process is difficult, because the lungs ·
are situated in a case, the walls of which are to a considerable
extent unyielding, and offer therefore an obstacle to that
contraction which healing or cicatrisation renders imperative.
This hindrance to healing in itself may tend towards ex-
tension of the morbid process, but this extension is specially
due to the lungs being in a state of constant movement.   In

this way any breach of continuity, or any inflammatory condition which will tend to this, cannot obtain the required rest, and any healing which may have occurred in spite of the unfavourable surroundings, will be again and again injuriously affected by the sudden violent movement which the act of coughing entails. Lastly, by the inspiratory and expiratory movements, and by the cough, extension of disease is directly promoted through transference of morbid material from diseased to healthy portions of lung. That lung lesion therefore should be frequent and progressive can easily be understood.

But why in phthisis should the apices of the lungs be chiefly affected? Both structural and functional considerations account for this.

In the first place, it is to be remembered that, owing to the lesser bulk of the upper as compared with the lower parts of the lung, the process of cicatrisation, after a loss of tissue above, will mean a much greater dragging upon the individual air cells than it will below. Thus the sectional area of a lung at the level of the third dorsal vertebra being about 5 square inches, and at that of the eighth dorsal vertebra being about 16 square inches, it is obvious that the amount of traction on each air cell which the obliteration by contraction of a cavity necessitates is very much greater at the former than at the latter level, that is, that the healing is rendered (to that extent) more difficult above than below. Secondly, whilst the walls of the thorax are, as has been stated, comparatively unyielding, the amount of wall rigidity is not the same all over. There is no doubt that above in the supra-clavicular region and below at the lower ribs and diaphragm a certain amount of yielding can take place. At the very apex, therefore, cicatrisation can, as far as this is concerned, occur, as shown by the supraclavicular hollows so obvious in cases of chronic phthisis, and by the observation that cavities are most common, not above, but below the clavicle.

If, now, we turn to the lower parts of the lung, we find greater facilities for cicatrisation, for by a comparatively slight alteration in the curvature of the more yielding chest wall and the still more flexible diaphragm, a loss of tissue such as would heal, opposite the second or third ribs, with difficulty if at all, can readily be allowed to cicatrise as far as filling up of the space is concerned.

Let us now inquire if, from a study of the functions of the parts concerned, any further information can be obtained on this question.

Here it might, in the first place, be surmised that the fact of there being much more movement at the lower parts of the lungs, should, in the event of a loss of tissue, militate against healing there, as compared with the upper parts, rest being for all such processes so important a requirement. To this it can only be replied, that if, from this, any advantage does accrue to the upper part, it is more than counterbalanced by functional disadvantages. What these disadvantages are we must now consider.

One reason very commonly given for the liability of the apices to the phthisical process is that they are functionally less active. It is necessary to explain what this means. Seeing that functional activity is required in order that trophic changes may be properly performed, and knowing that the respiratory movements of the upper parts of the lungs are less than those of the lower, it is evident that any impairment of the nutritive processes in the lung as a whole is most likely to show itself in the first place at the apex. It has been stated previously that phthisis is a result of deficient respiratory function; that it should occur most readily at the apex follows as a matter of course. The fact, further, that there is less movement at the apex will influence the activity of the lymphatics, the effect of movement in aiding the passage of lymph along the lymph channels having been shown by numerous experiments. At the apex,

therefore, the process of absorption will not, we may suppose, be performed so well as at the lower portions of the lung.

A further important item in this connection is the effect of coughing. In coughing the thorax is more or less vigorously contracted, and at the same time the air is prevented passing out by the closed glottis. The lower part of the thorax, corresponding to the diaphragm and lower ribs, is the part most pressed upon, and as at the supraclavicular regions the parietes are yielding, air from the lower parts of the lungs will be driven to the apices. Such an action is well demonstrated if we examine in an emphysematous subject, the supraclavicular region during a cough paroxysm. Distinct bulgings of the lung apices at the root of the neck can then be seen with each cough. Not only, however, will air be driven there, but any solid particles, inhaled dust, mucous secretion, &c., will of course be similarly dealt with. Having got there, there they are likely to remain ; for the movement of the upper parts of the lungs being comparatively slight, there is little chance of their dislodgment.

The weight of the arms has been stated so to interfere with the movements of the upper part of the chest, as to form an item in the production of apical as compared with basal phthisis. Whether this opinion has been founded on clinical observation or not, I am unaware ; my own experience leads me, however, to suspect that it has not. In three cases under my observation, in which the arm had been amputated for injury close to the shoulder, and in which phthisis had developed many years subsequently, the disease was confined to the side on which the arm had been removed, and in the case of a lad of nineteen, in whom both arms had been amputated when he was three years old, in consequence of a tramway accident, death occurred from rapid tubercular phthisis of both apices, specially the right. From such instances, so few in number, no definite conclusion can be drawn ; they are, however, of sufficient importance to warrant mention.

To the influence of the erect posture, the extra liability
to phthisis of the apices in man has also been ascribed, and
bearing this out is the observation, that in monkeys, which
share with human beings the liability to this disease, no
such localisation can be demonstrated. What has just been
mentioned may however apply here, for if, as the result of the
removal of the arms, an increased tendency to apical disease
is brought about, the constant use of the arms, such as obtains
in the quadrumana, will correspondingly protect these parts
from disease.

When we next consider the effect of the respiratory move-
ments upon the blood in the pulmonary capillaries, another
important point in connection with the relative liability of
the upper and lower portions of the lung to phthisis comes
into view. In discussing the conditions determining the
occurrence of œdema of the lungs as distinguished from
hydrothorax,* it was shewn that, in cases where, as the
result of congestion of the pulmonary vessels, or of a
watery condition of the blood in those vessels, a liability
to serous transudation has occurred, the effect of the re-
spiratory movements, more especially of inspiration, is, when
the air passages are free, to draw this fluid to a large
extent into the pleura (hydrothorax), whilst if these pas-
sages are occluded, to draw it into the air cells (œdema
pulmonum). Applying this to the individual parts of the
lung, we may conclude, that where the lung movement is
greatest, there will be, in the event of any obstruction to the
ingress of air, the greatest tendency to aspiration of fluid
into the air cells. It is obvious, therefore, that in cases of
bronchial catarrh, with slightly obstructed air tubes, the lower
parts of the lung will be much more likely than the upper to
experience that watery condition so counteracting to caseation.
It may be said also, that the lower parts of the lung will be
more watery, as the result of gravity.

* *Medical Times and Gazette,* 1880.

The observation of other lung affections, bears out one
or other of the above considerations. Thus, comparing
croupous pneumonia of the upper and lower portions of the
lung, it would appear that, in the former, entire absence of
sputum is more frequent, that the dulness generally lasts
longer, that the fever is later in subsiding, and that delirium
is a commoner associate, all of which might reasonably enough
be ascribed to the exudation in apical cases being got rid of
either by coughing or absorption with greater difficulty.* In
connection with the lymphatic system of the lungs, it is
interesting also to notice that, in cases of acute miliary tuber-
culosis, where the nodules are scattered over the entire lung,
they are usually more thickly aggregated at the upper than
at the lower portions. Seeing that in such cases the develop-
ment of the disease has probably been caused by resorption
of tubercle from a distant point, *e.g.*, strumous knee or elbow
joint, &c., it is of importance to compare with it the obser-
vation, that other morbid conditions developed as the result
of resorption and transference seem to affect other parts of the
lungs as readily. For example, hydatids, secondary cancer,
and emboli, occur as frequently or more so at the bases of
the lungs.

The occurrence of basal phthisis itself is in this question
also of special interest. Such cases are, of course, met with
much more rarely, the proportion to apical being according to
Cotton 2 per 1000, according to Walshe and Pollock 1 to 70.
In 400 cases, the notes of which I have been able to consult,
it occurred 19 times. Of such cases it would be of interest
to distinguish those which began in the same manner as is
usual with apical cases, and those which resulted from unre-
solved pleurisies and basal pneumonias. In the 19 cases above
alluded to, only five began in the manner first mentioned,

* Compare Reynold's System of Medicine, vol. iii., p. 627 ; Walshe, *ibid.*, p.
358 ; Ziemssen's Cyclopædia, vol. v., p. 499 ; and *British Medical Journal*, 1884,
p. 1082.

the physical signs being a slightly impaired percussion note, with a weakened respiratory murmur and a few crepitations, followed shortly afterwards by unmistakeable signs of a small cavity.

Basal phthisis is said to occur at a later age than apical, and to have associated with it a more chronic course. This latter statement can be readily understood from what we have just considered as regards the conditions obtaining in the upper and lower portions of the lung. Basal phthisis is much less frequent in the female sex. Out of 64 basal cases noted by Pollock, 50 were males, 14 females.

This relative immunity from basal phthisis in women might seem inconsistent with the view that phthisis tends to develop in the least used part of the lung, inasmuch as in women the breathing is described as being of the superior costal type. I believe, however, that it may be explained by the supposition, that whilst apex phthisis is for the most part the result of deficient air and exercise, basal phthisis is brought on comparatively much more frequently by exposure, and follows bronchitis, pleurisy, and pneumonia ; and that as the male sex is much more liable to the latter affections than the female, it shows a preponderance of basal phthisis.

The relative liability of the two lungs is a subject upon which much has been written that is contradictory. Some (Lænnec, Williams) found it most common on the right, others (Louis, Cotton) on the left. Cotton, Walshe, and Pollock consider that softening and cavity formation begin more frequently on the left side ; and Pollock states that in incipient phthisis of the right side the chances of healing are more favourable. This relative liability to softening and cavity formation on the left side is of interest in connection with the predominance of pneumo-thorax there. Of such cases Louis gives 7 out of 8 on the left side, Walshe 55 out of 85, and Powell 9 out of 15. Seeing that the pneumo-thorax of phthisis usually occurs on the side in which the disease is

less advanced, this would seem to bear out the somewhat inexplicable statement, that although phthisis more commonly may begin on the right side, softening and cavity formation are more common on the left.

Little of value in the way of data as to the etiology of phthisis can be drawn from the consideration of the relative liability of the two lungs. It is interesting, however, to notice that croupous pneumonia seems to act in this connection in a very similar manner. Thus it has been stated that the proportion of pneumonia of the right side to that of the left is as 5 to 3 or 7 to 4, and that if we take pneumonia of the upper lobe alone this proportion appears much greater, 2½ to 1 (Grisolle), 18 to 1 (Barth), 18 to 4 (Briquet), 9 to 1 (Barthez and Rilliet).

What is it that leads to the formation of a cavity in the lung? Here we need not discuss the various pathological processes to which this may owe its existence. Catarrhal pneumonia and tubercular deposit are the commonest of these, and other conditions, as croupous pneumonia, hæmorrhage, wounds, cancer, foreign bodies, have all been recorded as acting in this way. All these, however, must possess a something as the result of which a cavity is produced. This something is the capability of inducing a loss of tissue.

In such a structure as skin, connective tissue, muscle, liver, or kidney, when as the result of some irritation a loss of tissue has occurred, if the irritating body and the products of the reactive inflammation can be got rid of, healing is comparatively easy. By contraction of the surrounding tissue, the space in which any irritating material might lodge is obliterated, healthy nutrition goes on as before, and the tissue is little the worse. It is evident, however, from what has been already stated, that it is quite otherwise in the case of the lungs.

Suppose that, as the result of a catarrh, a number of terminal bronchi, with their infundibula and associated

alveoli, have become filled with a cheesy mass, that the tissues of the walls of these bronchi and of the corresponding alveoli have been infiltrated and dissociated with a similar substance, and that thus a mass of caseating material, the size of, let us say, a hazel nut, has been produced. This must be got rid of; but how will it fare with the space in the lung thus occasioned? The mass is, of course, got rid of by a softening, which, beginning at its centre, extends through it, liquefying it, so that its expulsion through a bronchial tube is possible. But it is to be remembered, whilst this inflammation, exudation, infiltration, caseation, and softening is going on, a reactive inflammatory change is taking place in the parts round about, as the result of which an encapsuling of the mass by fibrous tissue is occasioned. Thus a cavity is formed, and the subsequent changes may most appropriately be considered as divided into, first, those which conduce to an increase; and, second, those which conduce to a diminution in the extent of the excavation. Let us consider, in the first place, the conditions which lead to an extension of cavity formation.

If a section of a cavity wall be examined microscopically, it is seen to consist of white fibrous tissue derived principally from the interlobular connective tissue, but also doubtless from the white fibrous tissue with which the yellow elastic fibres of the air cell walls are supplied. This tissue, like all living tissues, presents for consideration the processes of waste and repair, and although the molecular and chemical changes upon which these depend take place all through its thickness, there is no doubt that, as Ewart points out, "the wall of a cavity is comparable to the medullary cavity of bone, for it sheds its waste products internally, and acquires thickness from without;" that is to say, that whilst the innermost layer is as it were constantly shedding itself, undergoing a necrotic change, so that when examined by the microscope it shows mainly caseous particles and decaying cells, the

outer layers are as constantly being added to by fibroid growth.

It is at once evident that the size of a cavity will depend to a large extent on the state of the balance between these two processes. Let them be equal and the cavity may remain for long unchanged in size, as for example in the type of cavity denominated " quiescent " or " secreting " by Douglas Powell. On the other hand, let the waste exceed the repair, whether as the result of an increase in the intensity of the necrotic process at its inner wall, caused by a special action of the bacilli which exist there,* or by bad drainage and the irritation of retained secretion, or as the result of deficient repair of the fibrous wall caused by constitutional debility, the cavity must enlarge.

Apart from these processes of waste and repair in the cavity wall, but influencing them materially, are many other circumstances. Foremost among these is, as we have already noticed, the position of the lung in the pleural cavity. Placed in a space larger than itself, the walls of which are comparatively unyielding, the size of any cavity in the lung will be influenced by its capability of dragging together the air cells round about, of dragging in the superjacent chest wall, or of doing both. We have already seen that we may suppose that the greater bulk of the lung below, and the more yielding parietes there, render cavities of the lower lobes comparatively uncommon, and that the like freedom of the very apices from excavation may be ascribed to the ready yielding of the chest walls of the supraclavicular region. On the other hand, the great frequency of cavities in the infraclavicular region underneath the second rib may be understood, when we remember that here the least favourable combination of the above mentioned conditions exists.

In connection with the forces which tend to cause cavity enlargement, another item is the respiratory movement.

* See Percy Kidd, " Medico-Chirurgical Transactions," vol. lxviii.

According to Rindfleisch, inspiration acts in this way. As the result of the enlargement of the thorax, he points out that the ingress of air, distending the air cells, must act similarly on the cavity, this latter effect being favoured by its size, by the thinness of its walls, and by obstruction of the bronchi and alveoli round about. To this view of Rindfleisch the objection has been brought forward, that inasmuch as the thin alveolar walls are much more easily distended than the fibroid capsule of a cavity, the inspiratory distension, by affecting them (the air cells) to the greater extent, will rather tend to allow the cavity to contract, and that thus inspiration, instead of leading to an increase, will lead to a diminution in the size of a cavity. Here we have an example of what can be often observed in nature,—a process which under different conditions will produce precisely opposite effects. Let the cavity wall be dense, or the opening into it be obstructed, and let the entrance of air into the surrounding air cells be free, inspiration will favour contraction of that cavity ; but let its wall be thin, let the entrance of air into it be free, and let the surrounding bronchioles afford an obstruction to the ingoing air, the inspiratory act will tend to the opposite effect. We must remember also that, although to the naked eye and to the microscope the fibroid walls of a cavity seem immensely more capable of resisting inspiratory distension than the thin walls of an air cell, the cavity is immensely larger than the air cell, and consequently, according to the hydrostatic law, internal pressure will act upon it with much greater effect.

The act of coughing will, there is no doubt, act in distending cavities ; and, again, according to the hydrostatic law, the larger the cavity the greater will be the effect. As Powell mentions, the interspace over a superficial cavity may be seen to bulge during the cough, and by the stethoscope the forcible entrance of air into it may then be detected.

But probably one of the commonest modes of extension is by coalescence of neighbouring cavities. By their mutual en-

largement the intervening tissue gradually becomes thinner and thinner till it is perforated, ulceration and tearing enlarges the opening so produced, and finally the partition disappears in whole or in part. In the latter case there are left the trabeculæ, so common in lung cavities, concerning the exact mode of formation of which there is some difference of opinion. Obviously, however, they must be formed by collapsed alveolar tissue, by interlobular tissue, or by blood vessels or bronchial tubes with their perivascular and peribronchial tissue, and seeing that in the alveolar walls there is the least amount of white fibrous tissue, it is probable that this last plays the least important part in their production.

The consideration of the enlargement of cavities by coalescence enables us to understand how, placed here and there in their walls, we may have, as it were, islands, formed by small portions of the lining membranes of the bronchial tubes. The tubes have been opened into, necrosed as the result of cavity extension, and leave these islands as their only remains. Similarly, and in precisely identical situations, we may meet with exposed blood vessels, the existence in which of the small aneurisms which occasionally rupture so disastrously, is of extreme importance. As regards the mode of formation of such aneurisms, we may suppose that while simple exposure of the vessels, that is to say, removal of the support of the surrounding tissue, will tend to cause their dilatation, yet that this occurrence will be more largely favoured by the changes in tension of the air and blood, the result of the respiratory movements, and more especially of fits of coughing.

Cavities, however, not only tend to increase in size, but in number, and this again to a large extent as a result of the respiratory movements. As has already been noted, let the debris or secretion of a cavity get into a bronchial tube, its inhalation into the corresponding air cells will almost certainly be followed by inflammation, exudation, and

caseation. In this way other parts (and as cavities are usually apical, lower parts) of the same lung become affected, but the opposite lung may also become involved, and it appears that the inframammary region is in such cases the usual seat of such a process. Similarly the bronchi, trachea, and larynx are said, as the result of coughing, to have their mucous lining infected by the sputum. But there is reason to suppose that the lymphatics and blood vessels of the lung may share with the air passages in the evil work of increasing the number of morbid foci, and in time, of lung excavations. All around a cavity, tubercular deposits can almost always be seen ; but as Ewart mentions, these are found with special frequency in densely aggregated masses in a certain definite position with regard to the cavity, viz., between its outer wall and the pleural surface over it. In position these therefore correspond to the course of the lymphatic channels, and they are formed there as the result of absorption. By their caseation and softening, secondary cavities will of course be produced. Extension of mischief may be, in the case of a blood vessel, the result of tubercular deposit in its wall, ulcerating into its lumen. Tubercular matter thus gets into the blood stream, and in the case of an artery is carried to the capillary area. There being retained, it is likely to act as a focus for further tubercular growth, and in time, for cavity formation.

Finally, cavities or dilatations of the bronchi may be produced or enlarged in another way. As the result of bronchitis or catarrhal pneumonia, an accumulation of small cells takes place in the interfascicular lymphatic spaces of the connective tissue of the lung (sub-pleural, interlobular, perivascular, peribronchial). A chronic interstitial pneumonia is thus induced, and just as in such an organ as the liver contraction of this new formed tissue must occur, so with the lungs. The effect, however, in liver and lung are strikingly different. In the former, the organ is much reduced in bulk ;

in the latter, it is not. The cause of this is, as Hamilton has pointed out, that the lung has a comparatively unyielding surrounding in the thoracic wall, and a comparatively yielding centre in the bronchial walls and in cavities. The contracting force therefore is expended in drawing the latter towards the former, that is to say, in stretching or enlarging dilated bronchi or cavities.

On the subject of the curability of pulmonary phthisis, Lænnec has said that "nature's efforts towards effecting a cure are injurious, and that those of art are useless." How much of truth there is in the first clause of this statement we have now had an opportunity of ascertaining. It is to be observed, however, that we are dealing with the subject of nature's efforts, and although so far as we have yet gone we have noted them to be acting in the mournful way in which they have been designated by Lænnec, we must remember that they are efforts at repair, and that consequently they must present to the observer a favourable, as well as an unfavourable aspect.

For example, the respiratory movements, and more especially the act of coughing, though too often acting so as to extend the lung mischief,—inspiration by drawing infective material into fresh air cells, expiration and coughing by driving it to other portions of the lung,—must often act beneficially by loosening and expelling the same. The lymphatics, too often acting in a similar way, and causing new foci by transference of morbid material, must sometimes succeed in their normal function of absorbing and removing such from an affected area, and the fibroid overgrowth which, as we have just seen, is apt to produce dilated bronchi, and to enlarge cavities, is capable in other circumstances of inducing the opposite effect, viz., cicatrisation ; and when we analyse the other physical phenomena and symptoms of phthisis, effects injurious on the one hand and beneficial on the other can be similarly demonstrated. We have now therefore to

consider how and to what extent the efforts of nature towards repair may be successfully carried out.

It must not be forgotten, however, that lung mischief stopping short of inducing loss of tissue may readily occur and as readily be got rid of. In apex catarrh,—the pathological condition in which is probably a blocking of the small bronchioles, with exudation into the corresponding air cells,—no destruction of lung tissue occurs ; the exuded material is removed by absorption and expectoration. But if mischief be more severe, if there be in addition to the filling up of the air cells and bronchi a cellular exudation into the alveolar walls, so that compression and obstruction of the capillaries take place, a softening and destruction of tissue will ensue, and, if healing is to occur, a true cicatrisation and contraction must follow. Lænnec stated his belief, that although in the early stages phthisis was incurable, yet in the later, "after the softening of tubercles, and the formation of an ulcerous excavation," a cure might occur. His view as to the pathological cause of the disease is of course different from that now held, but the salutary aspect of softening, expectoration of lung tissue, and cavity formation, is patent to every one.

The extent to which the healing process may occur of course varies. There may be complete cicatrisation, and practically speaking, restoration to health, or nature's efforts in this direction may fall short of this to any degree, and the main conditions which guide us in estimating the chances of complete or partial healing of cavities are, their size, number, position, and the opportunities for contraction afforded to them by the surrounding parts.

From the fact that bronchiectatic cavities large enough to contain many ounces of fluid can undergo very great contraction, as is seen in the results of lung surgery, but little information as to the influence of size on the healing of phthisical vomicæ can be obtained, inasmuch as, whilst the former cavities are produced mainly by internal pressure,

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causing compression and collapse of the surrounding lung tissue, the latter are mainly the result of destruction of lung substance. To state the size of a true phthisical cavity which may come within the limits of complete cicatrisation is impossible.

Their number is of very great consequence, for it is evident that cicatricial contraction of one may not only tend to impair this process in another, but may actually induce its enlargement. The healing process will most readily occur therefore when the cavity is single, and when the surrounding lung tissue is healthy. The position of a cavity next requires consideration. We have seen previously that the greater the bulk of lung tissue around, the less will each individual air cell be affected by cicatricial dragging. Hence, *cæteris paribus*, a true phthisical cavity in the lower lobe should have a very much greater chance of healing than one in the upper. But the question of escape of contents by drainage comes prominently into view, and here the advantage is entirely with the upper lobe. A further consideration is the position of the cavity as regards the chest wall, for the extent to which this is capable of yielding varies at different parts. At the very apex, that is to say, in the supra-clavicular region, considerable yielding can occur; opposite the second and third ribs very little, this being, as we have seen, the probable explanation why the usual locality for cavities is sub-clavicular. The condition of the thoracic walls at their lower portion is much more favourable for the diaphragm, the position of which varies within wide limits, and the costal arches, which form a wider span, and consist in greater proportion of cartilage, can yield to a much larger extent. A point also of considerable importance in cases of excavation in the lower lobe, as for example, after pleuritic effusion, is to note the width of the intercostal spaces. It is evident that when the ribs are completely approximated, further yielding can hardly occur.

Of great importance in connection with the structure of the thoracic wall is the condition of the pleura. The visceral

and parietal layers are usually adherent, and, corresponding
with the great development of the connective tissue of the
lung itself, there is a like condition of the connective tissue
of the pulmonary pleura. The result is the formation of
a layer of such a thickness as to permit of considerable
farther shrinking of the lung. In basal cavities, as after
pleurisy, this thickening reaches a much greater extent than
in apical phthisis, but in the latter class of cases, the position
where it is thickest is noteworthy. This is in the axillary
region, at the point corresponding to the greatest convexity
of the ribs, that is to say, at the point where yielding of the
chest wall can least readily occur. This farther demonstrates
the salutary signification of pleural development, and it also
indicates the method of its production, a subject on which, I
think, a little more may appropriately be said. Powell, in dis-
cussing this subject, points out that adhesion having occurred
between the two layers as the result of a pleurisy, the thicken-
ing will follow as the result of the inspiratory efforts. By these,
he says, the pleuritic adhesions will be stretched, and the two
layers tend to become separated to an interval of "half or three
quarters of an inch. This space is at first filled by serous fluid
effused into the meshes of the areolar tissue of the stretched
adhesions. We thus get the œdematous pleura. At a sub-
sequent stage, however, of the disease, by the continued growth
of the areolar tissue, the whole space becomes occupied by
tough, fibrous tissue, and the two layers become completely
welded together into one uniform fibrous thickness."

The growth and development of fibrous tissue in the pleura
sometimes occurs so as to form long firm bands between the
costal and pulmonary surfaces. Over lung cavities these are
very frequent, and they are brought about by the combined
action of their contraction and of the respiratory movements.
This band formation and lengthening is of course in itself
directly salutary, and it indicates that a salutary process is
being more or less successfully accomplished.

It is to be remembered also that the fibrous tissue bands or trabeculæ, which stretch across cavities, may, as the *chordæ tendiniæ* of the heart do to some extent, act as stays or guys in preventing distension.

But a process of extreme importance in connection with cavity contraction is the dragging of the mediastinum and heart towards the affected side, and the consequent enlargement (hypertrophic emphysema) of the sound lung. This, in long standing cases, takes place to an extreme degree. Should the right side be the affected one, the heart may be felt in the fourth right interspace, and by percussion and auscultation the anterior border of the left lung may be found about the second, third, and fourth costal cartilages, to reach to the right side of the middle line. If the left be the affected side, an even greater displacement of the right lung to the left side can be made out, the heart's impulse can be felt displaced upwards and to the left, and, in the second interspace, the systolic and diastolic impulses in the pulmonary artery can usually easily be detected. In such cases, cavities,—the efforts towards healing of which has been the cause of this displacement,—can often be detected by auscultation extending into the axillary region. There is no doubt, then, that in this enlargement and extension of the sound lung we have an important example of nature's efforts towards healing. In all cases we look carefully for evidence of it, and inasmuch as it can only occur in the case of a sound lung, we can understand the immense importance as regards prognosis, of the disease being unilateral.

In connection with the etiology of phthisis, as viewed from the standpoint of the physical conditions of the respiratory organs, the results of pneumatometry and spirometry merit detailed consideration.

Pneumatometry.—Whilst in the normal condition the forced expiratory power always exceeds the inspiratory,—as the result probably of the fact that the elasticity of the lungs and chest

parietes aids the former to the same extent as it opposes the latter,—in phthisis it has been observed that this relative excess of the expiratory force over the inspiratory is increased. Waldenburg and others have shown that in slight cases the inspiratory power is diminished whilst the expiratory is normal, and that in more severe cases, with a diminution in the expiratory power, there is always a relatively greater diminution in the inspiratory. It is of interest to note that this condition is the exact reverse of what obtains in emphysema, which is, as we have already seen, a pathological change in many respects to be regarded as antagonistic to the phthisical process.

This inspiratory insufficiency, as it has been termed, can frequently be noted in phthisis before there is any wasting of muscle, and so has been ascribed to an increased respiratory resistance, due to inflammation or cirrhosis of the lung tissue, or to the adhesions between the pulmonary and costal pleura, so common in the phthisical.

There can be no doubt that such a condition of lungs or pleura will produce this effect, but in the absence of such, that is to say, in individuals only predisposed to phthisis, a diminution in the inspiratory force can frequently be detected. The explanation of this seems to me to be that, as the result of the deficient function which a too sedentary life entails, there will occur a comparative rigidity of lung tissue and chest parietes, *i.e.*, the lung elasticity and the chest wall elasticity will offer a greater resistance to the inspiratory muscles than they would have done had they been placed under more favourable conditions of hygiene and exercise, and, further, that although the patient has not observed any weakening of his muscularity, yet for the same reason this will be below par.[*]

All who are in the habit of examining chests recognise the auscultatory signs of deficient function of the upper parts of the lungs, in the occurrence of a little fine crepitation at the end of inspiration, which disappears after a few full

[*] Compare Jaccoud, "Phthisie Pulmonaire," p. 100

respirations or after coughing. The cause of this is no doubt the separation, by the entrance of air, of the walls of air cells—air cells which, collapsed as the result of disuse, have allowed their walls to become as it were glued together. That such a condition must indicate increased resistance on the part of the lungs and chest parietes to the inspiratory muscles, and comparative feebleness from disuse of these muscles themselves, there can be little doubt.

Spirometry.—By the spirometer, as is well known, the phthisical show a greatly diminished vital capacity, and it has been for long, indeed, supposed that phthisis acts in this manner more than any other affection. This of course is, as Waldenburg points out, an error. Cases of emphysema frequently show as great a diminution in this respect as do cases in the last stage of phthisis, and Waldenburg, Wintrich, and others state that they have met with cases in which the phthisical process indubitably existed, and yet which showed, as regards respiratory capacity, no deviation from the normal. This certainly accords with my own experience, and the explanation of it which I would offer is, that individuals predisposed to phthisis have usually a great vital capacity, and that, consequently, any slight phthisis either does not diminish it to less than the normal, or if it does, it is only to a slight extent. Why a large respiratory capacity should predispose to phthisis has been alluded to in a previous chapter (see page 14). Here it is only necessary to state that this conclusion, which may seem to many at first sight incomprehensible, is not based on theory. Four years ago I obtained, in an institution to which I am medical officer, the age, height, chest measurement, and spirometric capacity of 300 boys and lads between the ages of seven and twenty years. At that time, all were in good health, but since then three have become phthisical. In each of these the vital capacity was noted to be distinctly above the average for their age and height.

Season.—The data upon which an estimate of the influence

of season on phthisis can be formed, have been obtained from various sources. Louis,* endeavouring to ascertain the effect of cold weather in connection with the disease, found that in 297 patients (170 in the Charité and 127 in the Beaujon) the months in which the earliest symptoms had manifested themselves were as follows :—

Months—	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Cases—	27	19	18	22	26	23	18	21	30	30	19	24

Lebert† gives statistics showing the number of phthisical patients admitted into hospital and also the number of their deaths at each month of the year. Adding these together the following are the results obtained (per cent.) :—

Months—	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Cases (p.c.)—	51·7	29·7	30·9	50·0	47·1	37·5	28·0	17·4	12·4	19·8	38·6	36·9

From the Registrar-General's Reports (Scotland) the following table has been constructed to show the number of deaths from Phthisis, Old Age, and All Causes, in the eight principal towns of Scotland during each month of the year (average of ten years, 1876 to 1885) :—

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec
Phthisis, .	290·3	265·9	313·2	316·4	325·2	306·4	270·2	248·3	221·5	231·5	226·0	248
Old Age,	116·9	101·1	101·7	93·0	82·6	80·	78·7	77·0	60·6	75·2	82·1	108·
All Causes,	89·7	85·1	85·5	84·5	80·9	74·8	68·8	66·7	64·8	68·0	75·9	86·

These statistics are represented graphically in the diagram, and they show that the mortality from phthisis is greatest in March, April, and May; that it falls during June, July, and August to its lowest in September; that it remains low in October and November, but rises in December and January; and that there is a slight fall in February. The practical importance of this is that it seems to indicate that phthisical patients for whom change of climate for a part of the year can be obtained, need not leave Scotland much before November, and should not return before June.

From the etiological point of view, however, the following points deserve consideration :—

* " Researches on Phthisis," Sydenham Society's Translation, pp. 506 and 507.
† " Klinik der Brustkrankheiten," ii., p. 462.

JAN.   FEB.   MAR.   APRIL   MAY   JUNE   JULY   AUG.   SEPT.   OCT.   NOV.   DEC.

Phthisis
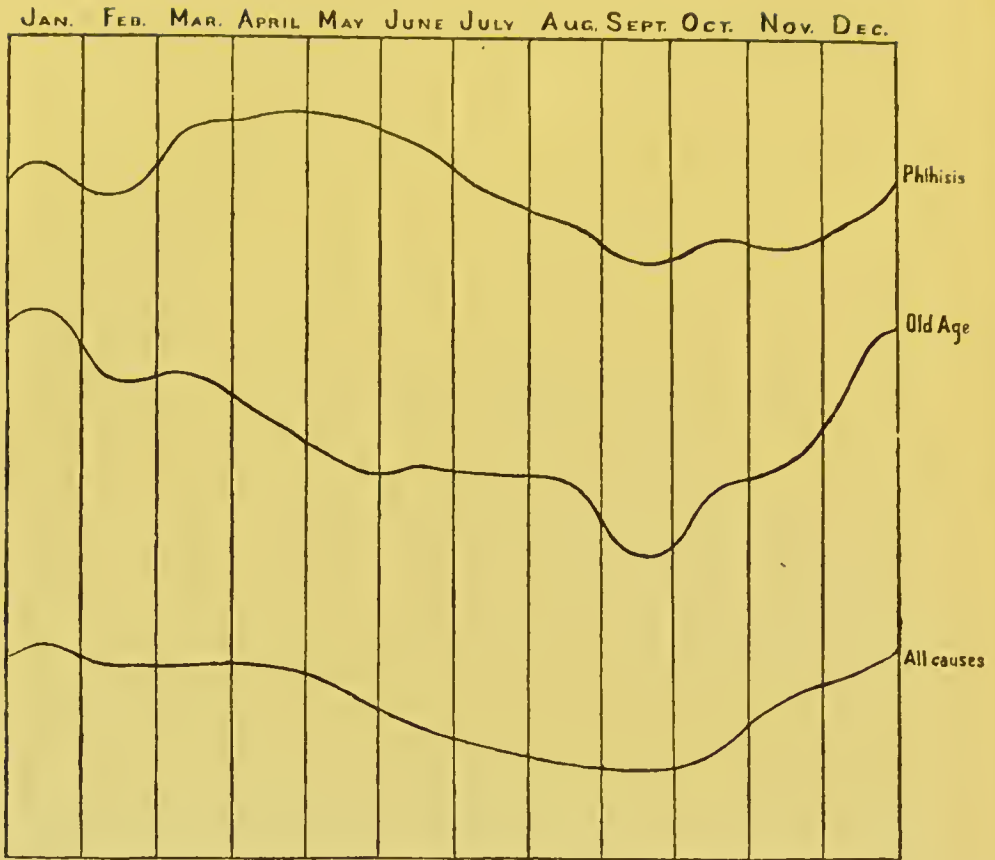
Old Age

All causes

Comparing the mortality from Phthisis with that from Old Age and from All Causes, it agrees with them in presenting its minimum in September, and a fall in February as compared with January, but it differs markedly in the high mortality which it represents in March, April, and May. Comparing again the phthisis mortality with that from all affections of the respiratory organs (for this I take the curves given in the article on the Influence of Weather on Mortality in the "Scottish Meteorological Society's Journal," vol. iv., see diagram), more of an agreement will be seen, in that they both show a high mortality in March, although in the latter curve a more distinct diminution in April and May is represented. It would seem therefore that, as far as season is concerned, phthisis is affected favourably or unfavourably by whatever

All Lung Diseases.   London.

Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov. Dec.
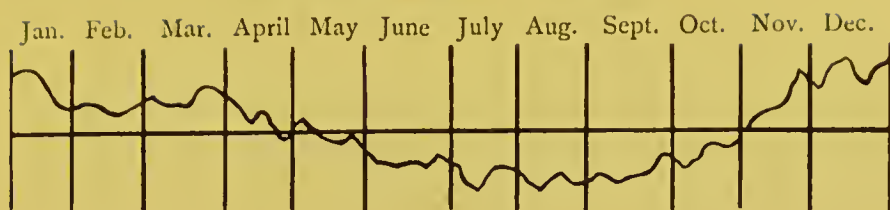
Tabes Mesenterica.   London.
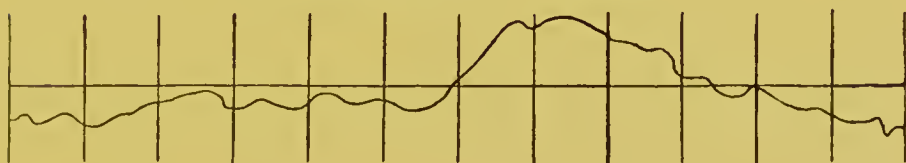
Enteritis.   London.
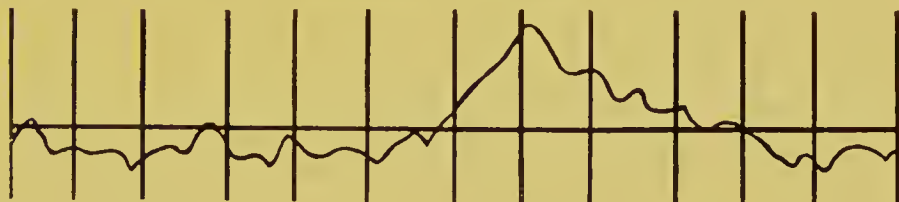
Hydrocephalus and Tabes Meningitis.   London.
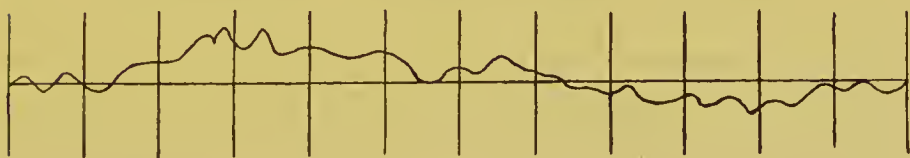
All Nervous Diseases.   London.
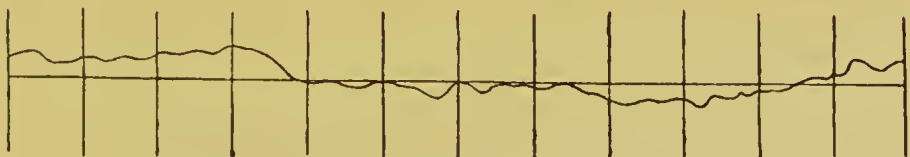
affects favourably or unfavourably the lungs as a whole. This conclusion is borne out by the consideration of the

relationship between season and Brain and Intestinal tubercle. Thus " Tabes mesenterica " is most fatal when other diseases of the intestinal tract, diarrhœa, enteritis, and jaundice, are producing most havoc, *i.e.*, in July, August, and September ; and a somewhat similar relationship can be traced between " Hydrocephalus " and other recorded nervous affections, as cephalitis, convulsions, &c.

Heredity.—From the family history point of view, phthisis may be divided into three varieties—hereditary, innate, and acquired.   By *hereditary* phthisis is meant, of course, cases in which one or other or both of the parents have suffered from this disease ; by *innate*, cases in which some such affection as struma, syphilis, diabetes, cancer, or rheumatism has shown itself among the progenitors ; and by *acquired*, cases in which complete freedom from all these conditions had existed among them.   Statistics show that the influence of heredity is to increase very greatly to the offspring the risk of phthisis developing, and when we reflect that among the acquired cases, with which the hereditary ones have been compared in order to demonstrate this result, there are probably several which are designated acquired only from lack of sufficient knowledge of the family history, and probably also many in which the disease would fall into the innate class, the great differences which such statistics show become all the more important.   The effect of heredity is further to cause the disease to develop in the offspring at an earlier age, and to run a more rapid course.   Double heredity, as regards phthisis itself, or as regards scrofula, syphilis, cancer, &c., is more serious than single : and as regards single heredity, it is acknowledged that the transmission is most apt to pass in the direct line, or from fathers to sons, and from mothers to daughters.   In cases where the transmission seems to have crossed from fathers to daughters or mothers to sons, a resemblance in face, figure, or mental characteristics, to the transmitting parent, can often be detected.

Marriages of consanguinity, when there is a family tendency to phthisis, or to such affections as cancer, diabetes, &c., are obviously most hurtful, and even where no such tendency is existent, the balance of opinion seems to be that they are on the whole injurious. As to the extent of the effects in this way there is, however, considerable difference of opinion.

Thus· " Dr Devay found in 121 marriages between blood relations, 22 childless, 17 excess of fingers, 2 absence of the little finger, 5 cases of pes equinus; in all the children the health was more or less impaired ; deaf mutism and hydrocephalus also appear frequently in marriages between blood relations." *

Pollock, although holding that phthisis may be not directly the result of consanguinity, states " that such marriages do not as a rule produce as vigorous an offspring as those of non-relations, and that such degeneracy of vital power as is due to this cause may in its turn become a predisposing, though not a direct, agent in the production of consumption." † He further goes on to say, " The converse condition is true also. Intermarriages of individuals remote from each other in ancestry, in social condition, in constitution, and in what is called ' temperament,' but above all the unions of persons of different race and country (if direct taint of disease be absent on both sides), are very generally free from resulting affections of constitutional origin in their children. It is perhaps true that marriages between individuals of different races are not very prolific ; and if this be the case, it is another reason for the greater vigour of their offspring, for the members of large families are generally not so individually strong as those of small ones." ‡ Theoretically and practically we incline to agree with Pollock's statement, and its scientific explanation is probably to be found in the recognised antagonism between the processes of nutrition and reproduction, as an argument

* Medical Adviser in Life Assurance, Sieveking, 2nd edit., p. 86.
† Elements of Prognosis in Consumption, p. 345.   ‡ *Ibid*, p. 346.

in favour of which Godron's law of hybrids seems specially cogent. This law is, that when crossing occurs between animals of different species, "there is a destruction of the physiological equilibrium in favour of the organs conducive to the life of the individual, and at the expense of those conducive to the life of the species." Thus the mule is proportionately stronger, hardier, and more enduring than either of its parents, the horse or ass; and hybrid plants present large stems, branches, and leaves. In both cases, however, this is at the expense of the reproductive function, for mules are almost invariably sterile, and hybrid plants are late in flowering. This brings us next to the question of fertility in connection with phthisis. That the phthisical are prolific, as Pollock states, is a matter of experience, and this seems to be the case in both the sexes, and even in advanced instances of the disease. Further, in individuals debilitated by other causes or diseases, a similar extra-fertility has been observed, twinning, for example, having been noted to be specially frequent among idiots, imbeciles, and their relations. Some explanation may be thrown upon this also by the Godron law before mentioned, but it should be remembered that sterility is also associated with the same debilitated condition. This apparent contradiction is evidenced by the data which Matthews Duncan brings forward, which demonstrate that sterility and twinning go together with too early and too late marriages, and is paralleled by Sir Arthur Mitchell's statistics, which show that immature mothers and old mothers are specially liable to bear idiot children.*

From the heredity and family history point of view the subject of malformations also deserves notice. The tendency to such in marriages of consanguinity has already been alluded to, and there is no doubt that the same abnormal condition which at one time manifests itself in malformation

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* "Fertility, Fecundity, Sterility," 2nd edit., p. 68; and see Sir Arthur Mitchell's Paper in *Medical Times and Gazette*, Nov. 15, 1862.

may at another do so in predisposing to phthisis or other constitutional affections. Many years ago my friend Dr Rutherford Morison, of Hartlepool, informed me that he had remarked a phthisical family history, in the proportion of about 8 to 10 of his cases of harelip, cleft palate, club foot, &c. Since then I have obtained corroboration from my own observations, and I have learned also that a similar association between twinning and lunacy on the one hand and bodily deformities on the other had been remarked.*

Finally, in connection with the subject of heredity in phthisis, the nature of the evil transmitted from parents to children requires notice. That it is the result of something of the nature of a tubercle germ being impregnated with the semen or communicated to the ovum has been hazarded in explanation, a view which is interesting as indicating the extent to which belief in the potency and importance of germs will lead. More probable is it that what is transmitted is a peculiarity of constitution which we vaguely term a condition of defective vitality, and whereby the brain, intestine, joints, lung, &c., are at successive periods of life specially liable to become the seat of tubercular disease. (See Table Chap. I., and Diagram I.)

Upon the nature of this constitutional state it is needless to speculate; it is much more important to ascertain if it is denoted by any peculiarity in the bodily structure and conformation.

According to Rokitansky the phthisical tendency was associated with a small heart, small vessels, and bulky lungs; and Rindfleisch,† after noting that tuberculosis in man depends in general upon scrofula, states that he looks for its cause " in a disproportion, during the development of the individual, between the volume of blood and the weight of the body. Even in the local affection of scrofulous persons there is

* Sir Arthur Mitchell, *Medical Times and Gazette*, Nov. 15, 1862.
† Chronic and Acute Tuberculosis, Ziemssen's Cyclopædia, vol. v., p. 646.

always a disproportion between the inflamed parenchyma and the absence of the proper congestion of the vessels." But probably the most exhaustive piece of work in connection with this subject is that of Beneke. In his " Constitution und Constitutionelles Kranksein des Menschen," he describes two main types of individuals : in the one there is a tendency to too little assimilation, in the other to too much ; the former condition he designates hypoplasia, the latter hyperplasia. As the results of measurements in a large number of individuals, he finds in the first class a relatively small heart, narrow arterial blood vessels, large lungs, small liver, and short small intestine. In the second he finds a relatively large heart, wide vessels, small lungs, large liver, and long small intestine. Individuals of the first type are small boned and lean, and have a tendency to osteomyelitis, scrofulous phthisis, and anæmia ; whilst those of the second, characterised by strong bones, good muscularity and often fatness, are liable to rickets, fibrous hyperplasia, adiposity, atheroma, psoriasis, and carcinoma, and if they become phthisical at all it is likely to be with the chronic fibroid form.

Whilst exception may reasonably be taken to many points in this theory, and more especially perhaps to those concerning the pathological tendencies, it seems to some extent to be true to nature. Any one, even the most robust, may take phthisis if his surroundings are sufficiently unfavourable ; but there is no doubt that an individual with feeble digestive and assimilative powers (anabolism), as denoted by small abdominal viscera and heart, and with great oxydising or disassimilative power (katabolism), as evidenced by large lungs (and great respiratory capacity), is specially disposed to it. Deficient lung function, the result of indoor life and quiet, will tell in the case of the large lunged with extra force, and mischief having once been started, the feeble assimilative power will render the occurrence of proper tissue repair extremely improbable.

CHAPTER IV.

PATHOLOGY OF PHTHISIS.

WHEN we examine the lungs of patients who have died of marked pulmonary phthisis, we find lesions which are numerous and complicated, the mode of production of which it is often difficult to interpret, and which show such differences in individual cases, that only a most general description of them can be attempted.

At the upper lobe will usually be found, with more or less thickening of the pleura, adhesions between the lung and chest wall, and in the tearing through of these to remove the lung, cavities will frequently be broken into. On section of the lung after removal, one or more of such cavities will be seen. These are usually very irregular in shape, and vary much in size. The larger ones often show ridge-like prominences of their wall, or it may be distinct trabeculæ. Free openings into bronchi can usually be easily detected in them, and they may be empty, or may contain a little pultaceous debris. In the immediate neighbourhood of these cavities the lung tissue is more or less condensed, owing to the growth and development of its fibrous tissue. Scattered over the cut surface small distinct deeply pigmented nodules can often be made out, which on section are seen to be composed either entirely of fibrous tissue or of small mortar-like masses surrounded by fibrous tissue capsules. Placed here and there among the cavities, and found also frequently among the comparatively healthy tissue of the lower parts of the lung, are numerous grayish coloured solidified patches. These vary in size from

that of a pea upwards; in the more central parts of
the lung they are rounded in shape, but when situated
near the surface they present a peculiarly wedge-shaped
appearance. In either case softening of their interior can
often be seen to be taking place, and varying with the
amount of this central softening, and with the freeness of
the communication between it and a bronchial tube, evidences
of different stages in the process of cavity formation can
easily be recognised.

In addition, multitudes of small grayish nodule-looking
bodies may be seen scattered about, which, when carefully
examined, show themselves to be formed by transversely
divided bronchi, plugged by caseous material, and the fibrous
tissue of the walls of which is infiltrated and thickened with a
similar substance. The larger bronchi show here and there
signs of having undergone dilatation, and the mucous mem-
brane has a peculiar glistening appearance, the result of
chronic catarrh and removal of the superficial epithelial
layers. With an emphysematous condition of the upper
parts and anterior borders, and a somewhat congested,
œdematous, or it may be hepatised condition of other parts
of the lung, these are in a general way the appearances which
that organ frequently presents.

The interpretation of such is not a very difficult matter.
The patches of grayish consolidation referred to show them-
selves, when microscopically examined, to be formed by a
distension of the air cells and infiltration of their walls by
cells which may resemble the ordinary epithelium which
lines the air sacs, or may be larger, about four or five
times the size of a white blood corpuscle (epithelioid).
Towards their centre the patches may show signs of break-
ing down or caseation, and then bacilli may, by appropriate
means, be demonstrated among them, or they may show
the well known giant cell.

The cells which are seen in the alveolar wall are like lymph

cells, and are probably to be looked upon as such, infiltrating the lymph spaces of the fibrous tissue. When such an infiltration is examined in the neighbourhood of a softened area, appearances of breaking down or caseation can then also be detected.

All these morbid appearances seem to indicate that by an intra-alveolar and extra-alveolar cell accumulation, pressure on the blood vessels, &c., of the part occurs, that nutrition is prevented, and that thus caseation beginning at the central part takes place, that an opening into a bronchial tube is formed, and that by the escape of softened and liquefied matter along this channel a cavity results. A catarrhal pneumonia, therefore, with its associated catarrh of the small bronchi, might, from what we have seen, account for all the morbid appearances.

In other cases, however, distinct evidence is found of the occurrence of another pathological process. Scattered over the surface of the section in greater or smaller numbers, and consequently in some cases detectable with ease, and in others with difficulty, are small grey miliary nodules. Round about cavities and round about the masses of consolidated lung tissue which are centrally undergoing softening, they are seen to be more thickly arranged, and from such they frequently spread outwards in a radiating manner. They often form conspicuous objects placed here and there in the walls of a cavity or of a bronchial tube, and they can be traced in the hypertrophied fibrous tissue of the interlobular septa, the peribronchial and perivascular tissue, and in the deep layer of the pleura. They follow thus the course of the lymphatic channels, a point which, as Hamilton indicates, is important, as denoting that in nature they are hyperplastic enlargements of lymphatic tissue, the result of absorption of caseating material. If we examine one of those nodules microscopically, —and for this purpose it is better to make use of the lower part of the lung where the nodules are more isolated, and where

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the surrounding lung tissue is comparatively normal,—we find it to consist of a capsule of fibrous tissue, from the inner surface of which there passes in a delicate fibrillar reticulum, in the meshes of which is an immense number of small lymphoid cells, this reticulum, with its cells, giving place centrally here and there to large giant cells. When several of such nodules coalesce, the result is the appearance of a little solid mass, which might be mistaken for one of catarrhal pneumonia, this similarity being intensified by the central portions in both cases undergoing caseation and softening, and showing the bacilli. Though their effects are the same, however, they are essentially different in nature. The catarrhal pneumonic process consists of a proliferation of the epithelium lining the air cells and infundibula, an infiltration with round cells of the fibrous tissue of their walls. By pressure of these new products on the capillaries, the circulation is obstructed, and nutrition being arrested, a caseation or slow necrosis of the mass occurs, beginning at the centre, and affecting at first the structures possessing least vitality, viz., the catarrhal cells, but in time involving the alveolar wall.

The tubercular nodule process, on the other hand, is quite different. Beginning as a little swelling in the fibrous tissue wall of an air cell or terminal bronchus, it gradually increases in size, obtaining space for growth by invaginating itself into the lumen, pushing the epithelial lining before it until, in the case of an air cell, it completely fills it. In this way a miliary nodule is formed, showing the fibroid reticulum, lymphoid cells, and giant cells; and should this process affect the walls of several adjacent air cells, we can easily understand how an appearance similar to that produced by small patches of catarrhal pneumonia is brought about. We can also understand how, with such a formation, a like obstructive pressure on the capillaries, and arrest of nutrition in the mass, will be induced, so that caseation, softening, and

when a free communication with a bronchial tube is established, cavity formation will also occur.

In a general way, then, the pathological conditions which in phthisical cases are to be looked for are, cavities, the result of catarrhal pneumonia and caseation, or of tubercular deposit and caseation, patches of catarrhal pneumonia or of tubercular deposit, in which the process of central caseation and softening can be detected to a greater or less extent, increase in the amount of cicatricial tissue, especially in the neighbourhood of the cavities and in connection with the pleura, dilated bronchi, emphysema above, with congestion and œdema below, and perhaps the presence in a marked manner of typical miliary tubercle nodules.

But although lung lesions such as these have to be looked for in every case, it is to be remembered that they may not all be present, and that the degree to which they are manifested varies within very wide limits. In correspondence with the great differences in the type of the disease, with the facts that its duration may vary from a few weeks or months to many years ; that in one case, the symptoms having manifested themselves, may have been continuous to the end ; and in another, interrupted by more or less prolonged intervals of comparative health ; that the nature of the environment of the individual, and that diathetic conditions are further capable of powerfully modifying its course, the morbid anatomy of phthisis presents very great variations. Although, in the majority of instances, cavities, fibrosis, catarrhal pneumonia, and tubercle, can all be seen in the manner described, the degree to which they severally participate in the change varies almost indefinitely. Thus the cavity formation may be present as a single small excavation at the apex, or a lobe, or, indeed, the entire lung may be transformed into a huge cavernous structure ; the fibrosis may be so slight as to be hardly recognisable, or it may be practically all that remains of the lung tissue : the catarrhal pneumonia may

show itself as small isolated patches, or it may involve an entire lobe; whilst, as regards tubercle nodules, still greater modifications are met with. The consideration of the last of these is complicated by the fact that there is great divergence of opinion as regards their causation and signification and the part which they play in connection with pulmonary phthisis generally. This subject will be discussed presently, but, meanwhile, it is sufficient to state, that whilst in a large number of cases of phthisis they exist pathologically as miliary nodules scattered over the affected lung, more thickly arranged round cavities and caseating patches, and forming conspicuous objects in the lining walls of cavities and bronchial tubes, they may, on the one hand, in spite of careful search, be non-detectable; or, on the other, with a small apex cavity, they may, thickly studded over the entire lung, appear to form the main lesion.

The question now arises, can we associate the morbid appearances with the symptoms and clinical history, so as to form for ourselves pictures of the very diverse types which the disease may assume? Undoubtedly we can, and the types which can readily be recognised are :—1, Catarrhal pneumonic phthisis; 2, fibroid phthisis; and 3, tubercular phthisis. Each of these is characterised by the predominance of the process which gives it its name; but we must remember that it is only a predominance, and that evidence of the occurrence with one process of the others is always to a greater or less extent to be looked for. In this way we shall consider them, and shall note their modifications. Before doing so, however, it is necessary for us to come to some conclusion as regards the general question of tubercle.

The idea that phthisis depends essentially upon the action of a virus or germ is an old one. Lænnec believed it to be an inoculable disease, but Villemin seems to have been the first to test this matter experimentally on animals. The method employed by him was to insert under the skin of

rabbits tubercular matter in various stages ; and he found, at
periods of from two to six months afterwards, that tubercles
were invariably to be met with in the lungs, liver, spleen,
lymphatic glands, peritoneum, &c. Villemin also ascertained
that this process of inoculation was more complete if the
tubercle was living, that is to say, if it were taken from an
animal when it was still warm. These experiments were
repeated by numerous observers, and inasmuch as they were
followed by a like result, the dependence of the disease upon
a virus seemed proved. Later it was further shown by Vir-
chow and others, that in cases of tubercular disease in man,
a source of infection in the body, in the form of a caseating
lymphatic gland, scrofulous joint, or diseased solid organ,
could always be detected.

Subsequent observations, however, seemed not altogether
to bear out this theory. In this country by Clark, Burdon-
Sanderson, and Wilson Fox, and in Germany by Walden-
burg and others, it was asserted that non-tubercular matter,
as pus, putrid muscle, pneumonic matter, pieces of lardaceous
liver, and even non-animal matter, as pieces of cotton, wool,
cork, &c., would, if similarly introduced into the tissues of
such an animal as a rabbit or guinea pig, induce in time
the same results as those brought about by tubercular matter.
Further, Cohnheim and Fraenkel stated, that for its production
it was in reality not necessary to inoculate at all. They held
that if in the rabbit or guinea pig a focus of purulent in-
flammation were produced, as could be for example by sub-
cutaneous fracture of bone and systematic movement of the
part so as to delay healing, a similar tubercular condition of
the organs would in time almost certainly supervene.

A general conclusion drawn from such experiments was,
that development of tubercle depends rather on the animal
experimented on than on the matter inoculated, being readily
induced in guinea pigs and rabbits, and with more difficulty
in cats and dogs. This is a view which has occurred to many,

and, from the physician's point of view, indicates that the
weakly and scrofulous, who are predisposed to phthisis, owe
their predisposition to a special liability to fall victims to the
ravages of the tubercular virus.   But more recent observa-
tions give greater prominence to the germ in this matter.
Watson Cheyne * relates a number of experiments in which
he introduced pieces of cork into the abdominal cavity, and
setons into the tissues of animals, and inoculated with vaccine
lymph, pyæmic pus, &c., and found that no tubercular disease
resulted.

On the theory that Wilson Fox's results might be due to
the access of tubercular germs to the animal experimented
upon through accidental contamination of the instruments
and substances used for the inoculation, Dawson Williams
repeated these experiments with strict precautions, and found
that no tubercular disease ensued.   The specificity of the
tubercular germ is still further indicated by the announce-
ment of Damsch, that in doubtful cases of urogenital dis-
ease, when purulent matter is found in the urine, a diagnosis
of tubercle may be made by inoculating animals with a
minute quantity of the purulent sediment.   For these experi-
ments he used rabbits, inoculating into the anterior chamber
of the eye, and he says that urine, purulent from any other
cause than tubercular disease, will not produce such effects.

Experiments have also been made upon the inoculability
and specific nature of the disease, by causing its introduction
into the body along with the food.   As an example of this,
the case reported by Jacobi, of the development of tubercle in
a dog which had been in the habit of licking up the sputum
of its phthisical master, has often been quoted ; and, as is well
known, some observers, as Klebs and Gerlach, have asserted that,
in using the milk or flesh of tubercular (perlsucht) cows, a great
risk of tubercular affection is run ; whilst others, as Colin, have
denied this.   On the production of tubercle in animals as the

* *Practitioner*, vol. xxx., p. 223.

result of thus feeding them, Orth * has made a number of experiments, finding that perlsucht matter had on rabbits this effect most markedly. In such animals he found the pharynx, lymphatic glands of neck, stomach, intestine, omentum, liver, spleen, kidney, pleura, and lung readily become affected ; and his results seem to show that even cooking cannot always be regarded as a guarantee against the evil effects of such food.

In connection with the production of this disease by the inhalation of morbid material, we have a number of interesting experiments. Lippl † and Reinstadler ‡ experimented in this way by causing the animals to inhale the inoculating material through a tracheal fistula ; whilst Tappeiner § and Schottelius ‖ placed the animals experimented upon in small chambers, and applied the infecting material by means of a spray-producer, thus impregnating the atmosphere with it, and causing its inhalation. Tappeiner administered thus to dogs the vaporised sputum of individuals with lung cavities, and found that tubercular disease of the lungs, liver, kidney, &c., could readily be induced in periods of about four or six weeks. Schottelius experimented also on dogs, but in addition to vaporized tubercular sputum, he employed simple bronchitic sputum, and such substances also as finely divided Limburg cheese, fresh calves' or pigs' brain, and powdered cinnabar. He states that in every case he produced an eruption in the lungs of miliary nodules, varying, however, quantitatively, being best marked with tubercular and bronchitic sputum, less with the finely divided cheese and brain matter, and least with the cinnabar.

Here, of course, it was a question as to whether or not the nodules in the lung consequent on the inhalation of those matters, were in reality tubercular. Schottelius considered

* Virchow's Archiv, Bd. lxxvi.   † *Ibid.*, Bd. lxxiii.
‡ Archiv für exper. Pathol. und Pharmakol., Bd. xl.
§ Virchow's Archiv, Bd. lxxxiv., p. 393.
‖ Virchow's Archiv, Bd. lxxiii.

that they were, and the microscopic appearances of lungs treated in this way seemed to bear this out, for, along with small nodules formed by distension of the air cells with catarrhal pneumonic products, and by blocking of the small bronchi through cell proliferation of their sub-mucous coat, he found nodules formed by interstitial cell growth, that is to say, by cell proliferation in the tissue of the alveolar septa and in the peribronchial and perivascular fibrous tissue.

More recently Bertheau * has repeated and extended these experiments. Using dogs mainly for the purpose, and taking care that the inhalation should be so conducted as to diminish as far as possible the risk of setting up simple inflammatory affections in the respiratory tract, he found that inhalation of tubercular matter caused in time the development of nodules in the interstitial, peribronchial, and perivascular tissues, showing epithelioid and lymphoid cells in a delicate fibroid reticulum, *i.e.*, showing, with the exception of giant cells, the typical structure of a tubercle nodule. Round about these nodules he found some air cells tending to become obliterated from pressure, and others containing catarrhal cells. Using the same precautions, he found that the inhalation of non-tubercular matter (pneumonic and bronchitic sputum vaporized) would not produce the same effects.

It is important to note that the experimental evidence as to the presence of the virus in the expired air is not altogether conclusive. Tappeiner † placed two rabbits in a small box into which a phthisical patient coughed ; and Gunther and Hanus placed five rabbits before the nostrils of a cow affected with perlsucht. In neither case did infection occur, and from such observations Tappeiner concludes that phthisis can be contagious only by the sputum drying, and particles of it in the form of dust impregnating the atmosphere. Giboux,‡ however, has come to an opposite conclusion in a series of similarly con-

* Deutsches Archiv für klin. Medicin, Bd. xxvi., p. 523.
† *Ibid.*, Bd. xxiv., p. 599.   ‡ Compt. rend. Acad. Sc., March 22, 1882.

ducted experiments, and as we shall shortly see, the bacillus has been stated to exist in the expired air of phthisical patients.

We now come to the consideration of experiments performed, not with tubercular matter itself, but with the micro-organisms procured from such, and submitted to cultivation. Into the history of these experiments we need not enter. With them the name of Koch is, of course, most intimately associated; but before him Schuler, Toussaint, Aufrecht, and others had either indicated the existence of micro-organisms or had succeeded in cultivating them.

Koch, by inoculating certain materials,—preferably specialised blood serum,—with tubercular matter, and by repeatedly taking small portions of the masses which occur in the growth of such and inoculating fresh serum, obtained in time a cultivation completely freed from all traces of the original tubercular matter, and which presented microscopically and in its behaviour to staining reagents, the well-known bacillus. With this he experimented on animals, his usual method being to inject a minute quantity of this growth, with a small quantity of distilled water, into the anterior chamber of the eye, the abdominal cavity, or under the skin. In every case tubercular disease supervened, and it is most important to observe, more rapidly than with the inoculation of the original tubercular matter. This may be explained either by supposing that, with the inoculation of tubercular matter as obtained from the bodies of man or animals, there would be an amount of local inflammation or suppuration set up such as would interfere with the absorption of the virus, or that by cultivation the virus becomes more virulent. The former is probably the correct supposition.

Koch further has demonstrated the existence of the bacillus in the affected organs of inoculated animals, in the lung and other organs in man affected with phthisis and tuberculosis, and in the sputum. So certainly is it present in phthisis that its detection in the sputum affords sure evidence of the disease. For

example, Dr Dreschfeld points out that whilst in all cases of real phthisis its presence in the sputum can almost certainly be recognised, in cases presenting symptoms resembling those of that disease, as bronchitis, bronchiectasis, pleurogenic phthisis, and syphilitic lung, it is conspicuous by its absence. In this way the examination of the sputum may be of the utmost value in diagnosis. But the bacillus, though thus an associate of phthisis, is by no means confined to the lungs and sputum. It has been recognised in laryngeal and pharyngeal ulcers, in ulcers of the tongue, in the expired air and sweat* of phthisical patients, in the fæces in cases of tubercular enteritis, in the pus from fistula in ano in the phthisical, in the urine in genito-urinary phthisis, in the nasal mucus of children suffering from tubercular meningitis, in the discharge of scrofulous ear disease, in scrofulous joints and in the pus from these, in the suprarenal capsules in Addison's disease, and in the skin in lupus.

Phthisis of the lungs, therefore, with similar affections of the other organs, is now more than ever regarded as the result of a specific virus ; and if we look for an expression of opinion in this matter, we cannot readily find a more characteristic one than that of Germain Sée.† He says :—

" Phthisis is then a virulent malady, due to a special micro-organism, which is specific, always inoculable to animals, transmissible from suffering man to healthy men by way of direct contagion, but much more frequently by heredity, very frequently localised in a single organ, and thus to be cured without compromising the rest of the body. The bacillus, on the contrary, whilst it lives, or whilst it invades all the economy, whilst it multiplies there, constitutes the danger ; it will continue its ravages."

Let us now rapidly revise the data, and see if we are led to a similar conclusion.

* Troup states that he has failed to verify this, " Sputum," p. 135.
† " Bacillary Phthisis," p. 4.

Like diseases induced by organisms, tubercle, after introduction into the body by inoculation, injection, or inhalation, will induce specific effects, these being the growth of tubercular matter showing bacilli in one or all of the organs of the body,—lung, liver, spleen, kidney, alimentary canal, lymphatic glands, and serous membranes. Its effects are not manifested at once; a period of incubation is required, during which a local effect only is existent, and this, with the fact that the quantity of inoculated material may be inconceivably minute, shows that, as with specific diseases generally, an enormous growth and development of the morbid matter within the body must occur.

Unlike the majority of specific diseases, however, it does not tend to end in recovery, and certainly it cannot be said of it as of many of these, that one attack protects against another. There is in this, however, no argument against the dependence of tubercle upon a germ. Clinically, evidence has been brought forward to show that tuberculosis may be recovered from, and pathologically, a transformation of tubercular nodules into fibrous tissue has been described; and although it is true that one attack of the disease is not only non-protective, but predisposing, the same can be said of erysipelas, an affection which owns its origin most undoubtedly to a germ. With erysipelas, and with ague, it presents a strong analogy, in that the specific virus may remain in the body innocuous, locked up, as it were, for years, and yet, in the event of any lowering of the general health, it may burst forth and induce general disease.

Unlike the majority of specific diseases, but yet like some of them, it manifests itself in two forms, a local and a general. The former is limited to a single organ, lung, testis, kidney, &c., and probably, because localised, gives rise to symptoms which may last for months or years; the latter rapidly affecting all the organs, soon ends in death. For an explanation of these differences in the manifestation of its presence, we may look

to the germ itself, or to the organism in which it is placed. That a germ may be modified so as to produce effects of varying degrees of severity, we have evidence in smallpox and vaccinia, and in the very great differences which can be produced in the potentiality of the germs of anthrax and of rabies as the result of cultivation.   But it is probably nearer the truth to suppose that this difference in the manifestation of the presence of the tubercle bacillus is due to the organism in which it is placed, for, as we have just seen, the tubercle bacillus, like the germ of erysipelas, or of ague, may remain innocuous for months or years, waiting, as it were, for a period of general malnutrition to enable it to manifest its injurious effects on the system.   Further, it is to be observed that in individuals of the diathesis in which the local form might be expected, the general form is common ; individuals of a phthisical stock are extremely liable to acute tuberculosis and *vice versa.*

As not altogether in harmony with the view that the disease phthisis is mainly due to a germ, the infrequence of contagion has been cited. Many examples of contagion, real or apparent, have of course been brought forward, but the records of consumption hospitals, and the fact that one often sees in a general hospital a phthisical case with numerous bacilli in his sputum, having alongside of him patients, the lungs of whom are either comparatively healthy, or are affected with fibroid, bronchiectatic or syphilitic disease, and yet in whose sputum or lungs no trace of bacilli can be discovered, seem incompatible with a belief in contagion. Certainly every hospital physician cannot but exercise the greatest caution in the manner in which he distributes the phthisical cases in a general ward, contemplating the possibility of contagion ; it must be admitted, however, that distinct evidence of this is practically non-existent, and the importance of this is increased by the probability that the virus of phthisis is distinctly atmospheric. All this indicates that although

the disease may depend on a germ, yet that the soil on which that germ falls is the more important element in its production.

Bearing out the relative importance of the soil to the germ, are several other considerations. In the first place is the proneness to tubercular diseases, supervening naturally or induced artificially, of the herbivora as compared to the carnivora ; secondly, the fact that in man the disease tends to affect different organs and tissues at different ages ; and thirdly, that in the immense majority of cases in the adult, it affects, in the first place, the apex of a lung, the part where, as we have seen, the process of nutrition is apt to be least efficiently performed.

Further, there is no question that, contrary to what we should expect were the bacilli the sole etiological factors in the disease, or even its necessary associate, their amount in the sputum bears no proportion to the severity of the symptoms ; and Kidd states in an article on the connection between the bacilli and the lesions of phthisis, that whilst in small caseating masses they are to be found all through, in cavities they are confined to the lining, *i.e.*, they do not penetrate far into the wall, and that wherever there is fibrosis there are few bacilli. Also that in many cases of advanced and widespread tubercular disease, the bacilli are found in small and even insignificant numbers.

Finally, if we compare phthisis with diseased conditions which all observations go to show are quite independent of micro-organisms, as insanity, very close resemblances are found. Thompson * has done this in a very interesting manner in connection with the consideration of heredity, and I feel that I cannot do better than adduce in a tabular form his statements. Comparing, for example, smallpox and syphilis with insanity and phthisis, we find, as regards hereditary transmission—

* " Family Phthisis," p. 132.

SMALLPOX.	SYPHILIS.	INSANITY.	PHTHISIS.
1. Transmission is from mother only.	1. Transmission is from either parent.	1. Transmission is from either parent.	1. Transmission is from either parent.
2. Disease in off-spring follows closely upon disease in the mother.	2. Disease in the offspring fol-lows, in all cases, the dis-ease in the parent.	2. Disease does not in all cases fol-low—it often precedes — the development of the disease in the parent.	2. The disease may appear in the child before it is developed in the parent, and the effect of in-heritance is cer-tainly manifest in the early death of the child from the diseases of childhood.
3. The transmitted disease is pro-tective.	3. The inherited disease is pro-tective.	3. The inherited disease is not only non-pro-tective, but predisposing.	3. The inherited disease is not only non-pro-tective but pre-disposing.
4. Atarism is im-possible.	4. The conditions of atarism are not known.	4. The disease may be transmitted by the parent without de-velopment.	4. The disease may be transmitted by the parent without de-velopment.
		5. Atarism is a fre-quent and im-portant char-acteristic.	5. Atarism is a fre-quent and im-portant char-acteristic.

Here the resemblance between phthisis and insanity is as complete as is their distinction from small-pox and syphilis, and this comparison indicates that whilst such diseases as small-pox and syphilis must be looked upon as being the results of some foreign growths implanted in the body as in a soil, and there passing through the various stages of their life history, insanity and phthisis may be regarded rather as being the results of some peculiar modification of the body itself, the nature of which we do not understand, but which we vaguely term deficient vitality. This view is further borne out by the consideration also brought forward by Thompson, that whilst with such a disease as syphilis or small-pox, the effects of the implantation of the virus are to render the body less and less capable of affording it a nidus, and so to lead to the extinction

of the disease, the effects of that modification of the vital processes which through heredity brings about phthisis or insanity, are to cause their greater and greater impairment, and so to lead to the extinction of the body.

The general conclusions therefore which we may draw as regards this matter are :—

1. That the bacillus of Koch, introduced into the tissues of an animal in the method followed by that observer, is capable (in the case of almost all animals) of germinating and producing general or local tubercular disease.

2. That this bacillus, as it may exist in the atmosphere which we inhale, can exercise its injurious effects on our lung tissues and produce phthisis, but that in order to do this the vitality of the tissues must be below par.

3. That this bacillus, having found its way into a tissue, joint, lymphatic gland, &c., may remain there for years incapable of doing mischief if the state of nutrition be good, and that its power for evil in any tissue of the body varies according to the amount of impairment of this state of nutrition.

4. That this bacillus is so ubiquitous, and that its effects for evil are so dependent on the state of nutrition of the tissues, that in the great majority of cases its importance as a factor in connection with the etiology, course, and treatment of phthisis, is subordinate to that of the tissue nutrition.

The application of these general conclusions to tubercular processes in the lungs may now be considered.

In these organs miliary tubercle may be found (I.) without any appearance of cavities or caseation, or (II.) with such, and so associated that there is no difficulty in tracing to them the origin of the tubercle. The first class comprises a large proportion of the cases of acute miliary tuberculosis which occur, and in connection with them the peculiarities to be observed are :—

(1) That the disease can be traced with more or less ease

to resorption from some tubercular focus in the body, lymphatic gland, scrofulous joint, kidney, prostate, testicle, &c.; (2) that the tubercle nodules are scattered thickly through the lungs from apex to base; (3) that the pleura, peritoneum, liver, spleen, kidney, or base of brain, are similarly affected; (4) that the bronchial glands are not enlarged; (5) that the symptoms are like those of a severe fever, death occurring usually in three or four weeks.

The second class comprises (II. *a*) a proportion of the cases of acute miliary tuberculosis, which supervene on phthisis; and (*b*) cases of chronic pulmonary phthisis with miliary tubercle.

In (*a*) the former of these, (1) the cavities or caseating masses in the lung can be recognised as the sources of infection; (2) the tubercle nodules are more thickly arranged round those cavities and masses; (3) the pleura, peritoneum, liver, spleen, &c., are affected, but not so markedly as in I.; (4) the bronchial glands may be enlarged; (5) the symptoms are like those of a fever, but not so distinctly as in I., the symptoms of pulmonary trouble, cough, dyspnœa, and cyanosis, being prominent.

In the latter (II. *b*), cases of chronic pulmonary phthisis with miliary tubercle, the appearances are different. Here with (1) cavities and patches of catarrhal pneumonia in all stages of progression and retrogression; (2) miliary tubercles are found round these as around foci, and radiating out from them in the newly formed fibrous tissue; (3) the nodules are comparatively sparse over the remainder of the lung; (4) little or no tubercle is found in the pleura, peritoneum, liver, &c.; (5) the bronchial glands are enlarged; and (6) the special symptoms of the miliary tubercular changes are not recognisable, there is simply aggravation of the phthisical symptoms.

Thus the special symptoms of miliary tuberculosis seem to vary with the markedness of its amount and distribution, and its amount and distribution seem to vary inversely with the extent of old standing disease in the lung.

Such being the forms in which miliary tubercle occurs, can any conclusion be arrived at as regards its nature? That it is a pathological condition, developed as a result of infection, disease and experiment alike enable us to admit; but it may well be asked, How is it that, produced in this way, and presenting structurally a like appearance in whatever tissue it may be found, the extent of its ravages and the corresponding severity of its symptoms differ so much? How is it that, in acute miliary tuberculosis, the serous surfaces and nearly all the organs of the body are involved, and symptoms so severe as to cause death in three or four weeks are induced, whilst in chronic pulmonary phthisis this miliary formation may be limited to the lung, and may be there so slightly marked as to be detected with difficulty, while the symptoms seem merely an aggravation of those of the original chronic disease?

Noting that the symptoms and pathological appearances are in correspondence with one another, there must be some reason for the fact that one individual, as the result of infection from a small apex softening, may develop general miliary tubercle, and die in a few weeks or months, whilst another, with numerous and large cavities and caseous foci all over his lung, may live for years, and in the end be found on *post mortem* examination to present only a few miliary tubercles in these organs, all the others being perfectly free.

In explanation we must look to, (1) constitutional conditions, and (2) the age of the patient.

(1.) *Constitutional conditions.*—As has already been seen, tubercle inoculation experiments on animals show considerable variations as regards success in different species, and it is equally certain that among individuals of the human species great differences as regards susceptibility to different diseases exist, in the way either of resisting their onset altogether, of suffering from them but slightly, or of readily and rapidly falling victims to them in their most severe form. We may

therefore suppose that the manifestation of tubercle in man is ruled by similar constitutional conditions. Given a tubercular focus, as a scrofulous joint, kidney, or testis, and a weakly constitution, autoinfection occurs and leads to general tuberculosis, and a similar manifestation will occur if the focus be in the lung itself in the form of a small caseous mass. Given, on the other hand, one or more such foci in the lung in an individual enjoying a strong constitution, autoinfection either does not occur at all, or it does so to the extent only of producing locally the development of tubercle nodules. These nodules may, by becoming aggregated, soften, break down, and add to the size of the original focus or cavity, or form new ones, but during the main course of the disease they remain local. Some weeks or months perhaps before death, in consequence of the debility induced by the long standing lung mischief, an extension of the area affected by these nodules may occur, but it is, as we have seen, rare for them to show themselves in any other organ.

[In explanation of this limitation of tubercle to the lungs in old standing cases, it might not unjustifiably be further adduced that an explanation is to be found in the severity of the miliary tubercular affection. The amount of miliary tubercle in the body being usually in the inverse ratio to the extent of lung excavation and consequent functional incompetence, we might suppose that the supervention of this complication in an individual heavily handicapped by extensive and old standing lung disease, causes symptoms sufficiently severe to prove fatal before it has had time to follow its usual course of extension to other organs.]

(2.) *Age of the patient.*—The association of general miliary tuberculosis with the earlier years of life has already been alluded to, and in explanation of this it has been noted that then the lymphatic structures function most actively, and that hence the risk of resorption from tubercular foci is at its greatest. It has been pointed out also that there seems to be a special

liability to tubercle at the time when growth stops and development begins, and that, as in the case of the brain, intestine, joints, and more especially of the lymphatic glands, this change is taking place in earlier years, there will then be existent correspondingly numerous sources from which auto-infection can occur.

How does the tubercular germ affect a so-called healthy lung in the first instance so as to constitute a phthisis? Premising that the germ is practically ubiquitous, its entrance into the lung tissue can easily be explained. In a delicate strumous individual, that denudation of the protecting alveolar or bronchial epithelium which will afford it an entrance will occur as the result of extremely slight and practically undetectable causes, and the nutritive power being impaired, tubercle nodule formation in bronchial, alveolar, or vascular wall will follow. On the other hand, in the robust, such an opportunity for entrance will only occur as the result of some temporary local cause, as catarrhal pneumonia. The subsequent course of events will correspond. In the former case there will be comparatively rapid extension of the tubercular process, caseation, softening, and cavity formation, little reactive inflammatory changes, and great liability to general miliary tuberculosis. In the latter there will be to a greater or less extent encapsulation of the softened tubercular products, or cavity formation and cicatrisation, the result of reactive inflammation, and there may also be the transformation of tubercle nodules into fibrous tissue, associated with which there is much less risk of the supervention of general miliary tuberculosis.

Finally, corresponding with what has just been stated, the clinical relations of the bacillus deserving of note are :—

(1.) That in incipient cases, where by physical signs little mischief can be detected, bacilli are to be found in the sputum, but in small quantities, and that in such circumstances their

presence has been quoted as having been useful in the diagnosis.

(2.) That when softening and cavity formation are occurring, bacilli are numerous, and it would seem that their increase may be observed before these morbid changes can be detected by physical examination of the lungs.

(3.) That when the softened caseous material has been got rid of, and a cavity or cavities have formed, the bacilli are fewer, and that in cases of quiescent cavity they may disappear altogether.

CHAPTER V.

TYPES OF PHTHISIS.

WE now proceed to the consideration of the disease Consumption, as divided into three types, pneumonic, fibroid, and tubercular, always bearing in mind that this classification is distinctly an artificial one, that with one type the others are always to be looked for as associates, and that therefore the type in reality indicates only the process in the disease which has taken the predominance.

We begin with the pneumonic; but before discussing it, it is to be remembered that there is a more or less insidious affection of the lung, which might readily be mistaken for phthisis, which may be the beginning of a phthisis, but which is, properly speaking, not phthisis at all. This is "apex catarrh," a morbid process which is not at all uncommon, which, with proper care, can readily be recovered from, and which,—seeing that in it, in favourable cases, resolution occurs without any destruction of lung tissue,—cannot be designated phthisis, although its symptoms and physical signs are hardly distinguishable from those of that disease.

What we have therefore to do is, to consider apex catarrh, and then the pneumonic, fibroid, and tubercular forms of phthisis, and the method followed will be to give a general description of the symptoms, pathology, and course of each, leaving to future chapters their more detailed consideration.

This plan will, I think, best enable us to grasp their distinguishing characters, and will save confusion and repetition.

In pursuance of this plan, we now begin with *apex catarrh,*

a condition which is not recognised clinically to anything like the extent which its importance entitles it. This is probably to some extent the result of the theory put forward by Lænnec and his school, that phthisis depended upon a neoplasm, and according to which, therefore, the bronchial catarrh preceding the development of the special symptoms of the disease, was to be looked upon as the result and not the cause of the malady.

To a greater extent, however, it is due to the symptoms which it induces being overlooked by the patient, or when complained of by him, to the difficulty of detection of the physical signs of the mischief on the part of the physician. By the older writers its existence is ignored, but since Niemeyer's work was given to the world, demonstrating that the catarrhal pneumonic process might form the main pathology of a phthisis, it has been more or less distinctly recognised.

Niemeyer himself, without naming it, specially describes it clinically and pathologically, and points out the immense importance of its recognition. Jaccoud refers to it as the primary condition of a phthisis which, though placing the patient in imminent danger, can readily be got rid of by treatment, whilst others, as Aufrecht and Powell, recognise and name it.

A patient affected with apex catarrh has of course a cough, usually worse at night, which he states has been troubling him for a few days or weeks. He will often say that he has frequently suffered from this before, but that this one seems to be sticking to him. His cough is accompanied by a spit, which consists either of clear mucus, or of such mingled with a few yellow streaks. He has a slight rise in the pulse and temperature, his skin feels soft, and he states that he does not feel so fit for work as usual.

On examination of the chest, but little in the way of physical signs can be made out. What there is, however, is

characteristic. At one or other apex the percussion note anteriorly, but more especially posteriorly, is of slightly higher pitch than normal, and on auscultation the breath sounds show either a prolongation of the expiration, with a harsh and frequently cogwheel inspiration, or a distinct weakening of the whole respiratory murmur. A few fine crepitations at the end of a forced inspiration may sometimes be detected.

With such a case, if rest in the house for a few days, with careful avoidance of talking and coughing be enjoined, if a small blister be applied over the affected apex, and a little Begbie's * mixture be ordered to ease the cough and improve appetite and digestion, and if thereafter the injurious effects of a too much confined life, and the risks of catching cold be avoided, all will go well, and with the complete disappearance of morbid physical signs, as complete a restoration of the general health will be effected.

The pathological condition here is the accumulation of cells in the small bronchi and air cells, as the result of a catarrhal process beginning in the bronchi, the consolidation induced mainly occurring in small patches at the apex. The accumulations are not dense, and the morbid processes on which they depend cease before any destruction of lung tissue by pressure on the capillaries or otherwise has taken place. Having ceased, fatty metamorphosis, liquefaction, and reabsorption occur, and the bronchi and air cells become again permeable.

The clinical history, symptoms, and physical signs by which apex catarrh can be recognised, thus seem definite enough, but it is to be remembered that modifications in all of them

* ℞   Acid. Hydrocyani, dil. ℨi.
      Acid. Nitric dil. ℨiii.
      Glycerini, ℨi.
      Inf. Quassiæ ad. ℥vi.
                    M.
Sig.   A tablespoonful in water thrice daily before food.

may be met with. Thus, whilst cough is usually the most prominent item among the symptoms, it not unfrequently happens, that it is complained of but slightly, and that impairment of the general health, loss of flesh, pallor, &c., appear to the patient and to his friends to be the conditions for which relief need be sought, or it may be that induced by a chill, catarrhal symptoms in connection with the gastrointestinal tract may mark the pulmonary affection. I have more than once seen apex catarrh mistaken for a slight case of typhoid fever.

The physical signs, too, deserve further remark. The slight impairment at one or other apex is often rather difficult to elicit by percussion, and requires very careful investigation. The method which I am in the habit of following is, to mark out by percussion the upper limit of each lung in the supra-clavicular and supra-scapular regions, and then carefully to compare corresponding areas on each side as regards percussion and auscultation ; bearing in mind that the right apex is the higher, and that, as the result of greater muscularity, the pitch of the note on that side may be somewhat raised, this source of possible error being most frequent posteriorly. Further, it is to be remembered that instead of an impaired or higher pitched note, a somewhat tympanitic or lower pitched note may be met with over the affected side, and this is apt to cause confusion, for when the normal note of the healthy side is compared with such, it (the healthy side) appears the duller, and consequently, to percussion, the sound apex may seem the affected one, and *vice versa*.

As regards auscultation, we have to remember that normally the respiratory murmur is, as a whole, louder, and the expiratory portion of it correspondingly prolonged on the right side, and that consequently the exaggeration of the normal sound to which an apex catarrh may give rise, is less easily detected on that side. Should, however, the effect of the catarrh be, by filling up the air cells to prevent ingress of air and weaken the

respiratory murmur, its detection on the right side will be correspondingly facilitated.

In addition to harshness, cogwheel rhythm, or weakening of the respiratory murmur, a few rhonchi or fine crepitations may be heard. The latter are best marked, as already stated, at the end of a forced inspiration, and in arriving at a diagnosis, care must be taken to avoid confounding these with the fine crepitation which is not unfrequently met with over the apices in lungs which are healthy enough, but in which some of the air cells have been collapsed, with their walls slightly adherent, as the result of disuse. To distinguish between them is often no easy matter, but the presence or absence of other abnormal physical signs, and the fact that the crepitation caused by a healthy but unused apex tends more readily to disappear after a long breath or after coughing than those produced by a catarrh, will help us to draw a conclusion.

Lastly, it is to be remembered that at the beginning of that form of phthisis which we class as the tubercular, the physical signs at an apex may be practically indistinguishable from those of apex catarrh. The general symptoms, however, are, as we shall see, usually very different, so that the distinction between them, so necessary for the prognosis, can generally be made with ease.

Such, then, are the symptoms and signs of apex catarrh. Both of these are often but very slightly marked. Since, however, the pathological conditions which their presence denotes tends, if neglected, to increase and to glide imperceptibly into the pneumonic form of phthisis, their recognition is of extreme importance.

Pneumonic Phthisis.—For the commonest form of this the following may serve as a description :—

With a history more or less distinct of having caught a cold, which has persisted in the form of a cough for some weeks or months, the patient acknowledges that previous to

any exposure his general health has not been quite up to par. If a man, this will be ascribed to his occupation having been a too sedentary one, or one followed under bad hygienic surroundings, or to want of work and consequent privation ; if a woman, there will be the oft-heard story of domestic toilings, excessive child-bearing, overlactation, &c.   In a certain proportion of cases, however, this preliminary stage of malaise is entirely absent.   The patient will ascribe the trouble solely to a chill, the effects of which have been sudden in their onset ; he will assert that prior to exposure his health had been perfect; and the most careful inquiry into his personal and family history and the nature of his occupation will fail to elicit anything which appears contradictory to this statement.   With the cough there will be expectoration, yellowish in colour, and at times perhaps streaked with blood, fugitive pains in the chest and shoulders, and dyspnœa on exertion.   The skin will be soft and moist, the pulse, compressible in character, will be accelerated some 10 or 15 beats per minute, night sweating will be complained of, and there will be to some extent loss of appetite and flesh, debility, and general malaise.

On physical examination the muscularity of the chest wall may be observed to be deficient, allowing the upper ribs anteriorly to be distinctly visible, whilst a flattening over one or other infra-clavicular region and a deepening of the corresponding supra-clavicular fossa will also be evident.   Over this area there will be increased vocal fremitus and a high pitched percussion note, and upon auscultation prolonged expiration, bronchial breathing, crepitation, and increased vocal resonance.   Similar physical signs will be detected over the corresponding portion of the lung posteriorly, and here the affected area will probably be found to be more extensive.   The other lung will be normal.

By cessation from work, rest indoors, with treatment as for apex catarrh for a few days, and thereafter a sojourn in the

country, or at any rate a general direction to be as much as possible in the pure open air, such a case will often, after a few weeks, return to his physician immensely improved. He will say that, except perhaps that he is a little short of breath if he does too much, he feels as well as ever he did in his life, his appetite will be better, he will have gained weight, his sweating will be gone, and his cough will hardly trouble him. On examination the pulse will be stronger, and normal as regards rate, and a corresponding improvement will be found in his skin and temperature. Upon examination of the affected portion of his chest, however, the results will not be altogether so satisfactory. The muscularity and adiposity of the chest wall may be better, but distinct signs of retraction in the form of supra-clavicular hollowing and infra-clavicular flattening will probably be found, the percussion note, though more resonant, will be still impaired ; and on auscultation the breathing will be similar in character to what it was before, with perhaps a slight weakening of the entire murmur. What it is, however, most important to note is, that crepitation can still be heard, if not with ordinary respiration, at any rate after a long breath or after a cough. With the firm conviction that if his health is not entirely restored, it will rapidly become so, the patient returns to work, and in spite of much in his mode of life and surroundings that is injurious, he keeps at it and is fairly well for weeks or months. Sooner or later, however, he returns, and he tells us that a fresh cold, over-exertion, or a bleeding, has brought his trouble on again, and he is vexed that he began work so soon after his last illness. All his old symptoms have returned, and in an aggravated form. His cough is extremely troublesome and often causes vomiting, his expectoration is profuse, and consists of opaque, greenish-grey masses, or of semi-purulent matter yellowish-red from admixture with blood. His pulse is again soft and quick, the temperature is correspondingly raised, and there are distinct hectic symptoms. On physical examination of the chest the

area of dulness may not seem on percussion to have much increased in size ; but on auscultation, the moist sounds are heard over a much larger area than before, especially posteriorly, whilst over the opposite apex, with a suspicious heightening of the pitch of the percussion note, a few crackles can be distinctly made out.

And now all treatment seems practically useless. At first, as the result of rest, and directions as regards diet and medicines, some slight amendment in the severity of the symptoms may be obtained.   The cough may be alleviated so that during the day the vomiting is less, and during the night some sleep is possible ; the sweating is less troublesome, and there is some diminution in the fever and improvement in the appetite and digestive power.   At any of these signs of improvement the patient is always ready to express satisfaction, but as time wears on the relief proves to be only temporary.   Gradually, all the severe symptoms return, and as against them treatment now seems powerless, they become more and more distressing.   The cough and vomiting allow no rest, and render the taking and retaining of food equally difficult, and the exhaustion so induced is terribly intensified by the fever and sweating ; extreme emaciation and feebleness ensue, and either suddenly from syncope, or more gradually after some hours of insensibility and collapse, death closes the scene.

The morbid changes in the lungs, which, taken together, constitute the process of pneumonic phthisis, are easily understood.   At present we need only consider them as associated with the symptoms and physical signs in a general way, leaving the precise relationship and causal connection between them to be fully discussed by and bye.

At the beginning of the trouble the condition of the lung apex is very similar to that which we have seen to exist in apex catarrh.   There is cell proliferation in the small bronchi and air cells, but now to a much greater extent, so that instead

of patches a large area of lung is more or less affected, and the consolidation is dense. At a part corresponding probably to the centre of this area, pressure on the capillaries is exerted. Obstruction to the circulation is here therefore brought about, and this is intensified by the cellular infiltration of the alveolar walls which also occurs. The interference with nutrition leads to a local necrosis, and it is at this period probably that the physician's advice is requested. By rest and treatment the inflammatory process is then arrested, the necrosed central area liquefies and is removed by expectoration, whilst absorption of the catarrhal products in the surrounding air cells takes place to a very considerable extent. Contraction of the cavity occurring with retraction of the chest wall and the development of some amount of emphysema, the patient, now that inflammatory action has for the most part ceased, and that the necrosed and softened material is in the main got rid of, feels comparatively well; and were he placed under favourable circumstances for a prolonged period, would almost certainly completely recover. He returns to work with its old injurious surroundings, and as the result of the weakened nutrition of the parts induced by the previous attack, and as the crepitation indicates also of the retention of certain of the morbid products in the cavity or surrounding air cells, or perhaps of the persistence there of a certain amount of inflammatory action, a second attack supervenes. This is worse than the first, because occurring after the general health has been impaired by the previous illness, and because affecting an organ which is scarcely yet sufficiently well to perform its normal functions, far less to battle against an abnormal process. More extensive areas of consolidation result, and though now, as the result of treatment, nature is ever making her efforts at repair, the balance is to the bad.

Though necrosed lung tissue and exudation matter is being got rid of here, and though inflammatory action is being allayed there, the salutary processes can never be complete,

all the injurious influences which we have detailed (Chap. III). come into play, the other lung becomes affected, and worn out by increased cough and fever, the patient's condition becomes more and more hopeless.

On *post mortem* examination, pleural thickening, adhesions, and cavities, with more or less surrounding fibrosis, will be found in other upper lobes, and here and there over other parts of the lung patches of catarrhal pneumonia, in various stages of softening, and cavity formation will be seen. Round about these cavities, in the induration tissues and pleural adhesions, may be found some tubercular nodules. Their presence, however, is not well marked, and there is little difficulty from the pathological as from the clinical side in concluding that we must regard the catarrhal pneumonic process as the main cause of the disease.

It is to be remembered here that the tubercular process may be much more obvious in pneumonic phthisis, may, as it were, clinically and pathologically engraft itself upon it; this, however, will be better considered when speaking of the tubercular type of the disease. As we shall also discuss by and bye, fibrosis may in the pneumonic process assume a more prominent position, and transform the disease into the fibroid type. Inasmuch, too, as the supervention of tubercle causes aggravation of the symptoms and acceleration of the disease, whilst that of fibrosis leads to corresponding alleviation and retardation, we are prone in our diagnosis and prognosis to incline towards the one or the other type, as the disease progresses or regresses. Apart, however, from these more or less distinct changes in its type, pneumonic phthisis shows very great modifications. From the general course of the affection just sketched out, and which may be supposed to present a duration of twelve to eighteen months, including three or four months of apparent arrest, individual cases vary very widely.

Next, in connection with the pneumonic type of phthisis,

it is necessary to remember that there are cases of consolidation and excavation of the lung tissue, associated with cough, fever, sweatings, progressive emaciation, &c., and which yet, because not presenting the bacillus in the sputum, are by many regarded as non-phthisical.

As a favourable example of such, the following may be quoted :—

A brewery worker, aged 45, had a cough and slight spit, which troubled him for three weeks, but which, when he stopped his liquor and took a little extra care to avoid exposure, became greatly diminished. He, however, then got a wetting, and the cold which ensued kept him in the house for two weeks. During this time the cough became very severe, and frequently caused vomiting ; he was feverish, lost his appetite, had thirst and sweatings, and lost flesh rapidly. After about a week in the house he noticed that his spit became more abundant, and that it had a very fœtid taste and smell, whilst his friends noticed a similar bad odour in his breath. On examination of his chest, a very dense percussion note over the supra-clavicular region and first right interspace in front, and over the supra-spinous region behind was elicited, with harsh cavernous breathing, coarse consonating râles, and increased vocal resonance over these parts. After this his fever diminished considerably, but the cough remained troublesome, and often led to vomiting, whilst the spit continued profuse, and with the breath retained a somewhat fœtid odour. The pulse and temperature were still raised, and he was still troubled with night sweatings, yet he was very much better, and, with tonics and sedatives and the use of antiseptic inhalations, he was after two months sufficiently well to be allowed to go to the country. On returning (some six months after the commencement of his first symptoms) he was very much better, he had gained weight and a large share of his previously healthy appearance. His cough persisted, but was not troublesome, and the fœtor of ex-

pectoration and breath had almost entirely disappeared, his pulse and temperature were normal.

On examination of the chest the appearances of cicatrisation and contraction were met with at the right apex; there was considerable sinking of the summit of the lung, with supra and infra-clavicular retraction; the percussion note was impaired, but much less so than formerly; and this appearance of improvement was heightened by the fact that, by percussion the anterior border of the left lung could, at the level of the second rib, be found extending to the right of the right border of the sternum. On auscultation the signs of a cavity were still detectable, but not to such a marked extent as was formerly the case. One year afterwards, this patient was again examined, his health meanwhile having remained very good. The signs of cicatrisation, as shown by retraction of the chest wall and dragging over of the opposite lung, were as marked as before, but the cavernous breathing had given way to a somewhat weakened and indeterminate respiratory murmur.

In such a case the initial pathological change is probably a pneumonia, in which the intra-alveolar, and, possibly, also extra-alveolar exudation and cell infiltration is so dense as to choke off nutrition and induce a limited gangrene. When, as usually happens, such patients are examined after the acute stage is over, bacilli and lung tissue are conspicuously absent from the sputum; in the earlier stages, however, lung tissue can usually easily be found. Though not always so fortunate as the example just given, such cases frequently end favourably.

In marked contrast to this form of so-called pneumonic phthisis, in which a comparative limitation of the inflammatory process has existed, is a form, the best name for which, probably, is that suggested by Douglas Powell, viz., acute disseminated pneumonic phthisis. In such the symptoms are like those of an ordinary phthisis, but much more severe,

the fever is higher, the hectic and sweatings are specially marked, the cough is incessant, expectoration profuse, and there is an entire absence of anything like attempts at arrest in the course of the disease, and death occurs after a few weeks or months. In many ways it resembles acute tubercular phthisis, but from it certain distinctions may be noted. In the pneumonic form the appearance of the patient is somewhat different, his face is flushed, and there is little of the pallid, anæmic, and depressed look of the tubercular form. His sputum very frequently contains blood, and the tubercular complications, diarrhœa, huskiness of voice, fistula, &c., are not so frequent. The physical examination of the chest shows a closer connection between the severity of the symptoms and the extent of the mischief; and, finally, although the sputum contains the bacillus, there is but little appearance of miliary tubercle nodules to be found in the lungs after death, whilst the destruction of tissue by inflammatory action is excessive in amount.

Fibroid Phthisis.

In the endeavour to form for ourselves pictures of the types which phthisis may present, the distinction of the fibroid is as convenient and as true to nature as are those of the pneumonic and tubercular. But from these two it differs in the important respect, that whilst they represent in an individual case the processes which are predominant in producing and extending the lung lesions, it represents the process by which nature is endeavouring to check the ravages of the disease. Hence, every arrest of a phthisis represents a fibroid change, and hence also, the longer the duration of a phthisis, *i.e.,* the greater the number of tolerably successful efforts at arrest, the more aptly may the disease be termed fibroid phthisis. Practically, therefore, fibrosis is a secondary salutary process; but we must bear in mind that, just as we gladly welcome the onset of symptoms and physical signs which denote that it is

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occurring, we must also be prepared to find that at any moment its predominance as a process may be lost. Although the fibroid form is one in which we can often give a comparatively favourable prognosis, we must remember that its very existence implies that a morbid process is at work, struggling, as it were, to gain the mastery over it, and that whilst, as months and years roll on, these morbid influences maintain their onsets with undiminished strength, the general vitality upon which the reactive fibrosis depends is gradually becoming diminished. Even in cases where, the amount of local mischief having been slight, a complete local fibrosis has occurred, so that, as the result of cicatrisation and encapsulation, the patient seems protected from farther injury from this source, we must remember that the fibrosis itself, physically by interfering with the performance of the respiratory act, or vitally by being a tissue less capable than the normal of withstanding functional wear and tear, is always to be viewed with suspicion. How much more gravely, then, must its presence be regarded when, much larger in extent, it is associated with but partially arrested disease. In all such cases we must be alive to the fact that, in addition to the more immediately injurious risks from a chill or a hæmorrhage, we have to contemplate the gradual failure of the vital powers, as the result of time, and of the perhaps insidious, but none the less continuous, workings of the disease.

The fibroid change may commence in and spread from the upper or lower part of the lung. In the former case, the more common of the two, it is consecutive to an apex phthisis or pneumonia ; in the latter, it occupies a similar relationship to a basal phthisis, a pleurisy, or a pneumonia. In either case, being a secondary change, its diagnosis can only be made after the original disease has been in existence for some time.

The following is a good example of such a case beginning at the apex :—

J. H., æt. 41, an upholsterer, was seen in the beginning of

May 1881. At that time I found him suffering from a very severe hæmorrhage; he was pale, and evidently anxious about himself, but his pulse, beating full and regular, was only 70 per minute, and his temperature was normal. On inquiry I found that, although he had never had to give up work, he had been suffering from cough and spit for the last five years, and that there was evidence that, some three years previously, his left apex had become affected. No bad symptoms showing themselves, he rapidly recovered from the effects of the hæmorrhage, and about ten days after seeing him I was able to investigate carefully the physical condition of his chest. With supra and infraclavicular retraction I found a slightly tympanitic note in the first left interspace, with a high pitched one below, extending downwards to the lower border of the third rib. Over the first interspace the breathing was bronchial in character, with marked crepitation and loud and clear vocal and whispering resonance, whilst below that, to the lower level of the dulness, the breathing was indeterminate, and the crepitations were much less marked. The physical signs posteriorly corresponded to those, and it was noted that the impaired percussion note and crepitations extended lower down there than in front. The cardiac impulse could be distinctly made out, displaced upwards and to the left, and by percussion and auscultation the anterior border of the right lung could be traced to the left border of the sternum, at the level of the third and fourth costal cartilages.

This patient returned to work, and continued at it till June 1882, when I had to see him again for another hæmorrhage, from which he as rapidly recovered and resumed employment. In April 1884 hæmoptysis again occurred. It was rather more profuse than formerly, but all through it his pulse remained full and strong, about 70 per minute. After a rest of two and a half months, he again felt well enough to begin work. In July of that year I found that, with much the same signs of chest wall retraction, exposure and displacement of the heart,

and extension of the sound lung as before, a distinct spread of the lung mischief had occurred. The percussion note anteriorly was somewhat tympanitic above, as it had been before, but the impaired note extended now as low as the fifth rib, whilst posteriorly the note was absolutely dull in the suprascapular region, and greatly impaired all the way downwards. Over the upper part of the affected area the breathing was bronchial, at some parts approaching the cavernous in character, with crackling crepitations and increased vocal resonance as before, whilst below, all over the affected area, especially posteriorly, distinct crackling crepitations could be made out. Over the supraspinous region of the right lung, further, with an impaired percussion note, a few dry crackling crepitations were audible. In August 1885, I was again asked to see him. This time there had been no hæmorrhage, but he stated that about a month previously increasing debility had compelled him to give up work. He was now feverish, his pulse averaged about 90, and was distinctly soft and compressible, his temperature was also raised, and he had occasional sweatings. Gradually the fever continuing, he became weaker and weaker, and tubercle, in the form of an ulcer of the tongue, showed itself. Without farther tubercular complication, he died in February 1886.

Here we have a case in which the mischief, beginning in the upper part of the lung—probably in a catarrhal pneumonia—spread downwards. Similarly, from a catarrhal or croupous (?) pneumonia of the lower part, it might spread upwards, and we meet occasionally with a case in which we are forced to believe a tubercular deposit in a lower lobe has in a like manner given rise to a fibroid phthisis. But of all the conditions which, originating below, lead to fibrosis, pleurisy, in which the absorptive process has been too long delayed, and consequently improperly performed, is probably the most common. In such a case the lower portion of a lung, with its air cells obliterated as the result of collapse, is

functionally incapable, its fibrous tissue, subpleural, inter-
lobular, peribronchial, and perivascular, sooner or later shows
a tendency to overgrowth, and as the result of the struggle
between it and the chest parietes brought about by the
absorption of the fluid, the lung striving to drag the parietes
inwards, the parietes·striving to drag the lung out, a dilata-
tion and sacculation of the bronchi is occasioned.   Retention
of secretion is thus caused, which, coupled with the weakened
nutrition of the part, leads to chronic irritation and spread of
the fibrosis upwards.   In many cases all the mischief spreads
thus from below, but now and again we can remark after
a pleurisy the supervention of a separate and distinct fibrosis
at the upper portion of the lung, originating probably from
a catarrhal pneumonia.

Finally, the possibility of a fibroid condition of the lung
being brought about by repeated attacks of non-effusive
pleurisy, must be borne in mind.   Given several such attacks,
a gradual thickening of the pleura, leading to a hyperplasia of
the white fibrous tissue of the lung, will occur, and thus will
be induced an obliteration of the air cells and dilatation of
bronchi in a manner similar to that which occurs as the result
of a single attack of effusive pleurisy with imperfect absorp-
tion.   Such an explanation suits in every way many cases,
and this morbid process has been fully described by Sir
Andrew Clark.   It is often, however, difficult to determine in
such patients that effusion has not actually occurred.   In
coming to a conclusion on this matter, the history of the
symptoms will guide us ; but from the fact that we often
find patients neglecting treatment until large amounts of
fluid have collected, we are inclined to suppose that con-
siderable effusions may pass through their course undetected,
i.e., may exist and become more or less imperfectly recovered
from.

In whatever way induced, the fibroid form of phthisis pre-
sents certain general characteristics which render its recogni-

tion easy. Of these slow progress is the most prominent, and it is to be remarked that not only is the inflammatory process in the lung a very chronic one, but that intercurrent bronchitic or catarrhal pneumonic seizures, or attacks of hæmoptysis, are in the case of favourable treatment readily and rapidly recovered from. Thus the general health remains for long unimpaired, so that when we examine a case of fibroid phthisis for the first time, we are apt to be surprised at the contrast between the patient's comparatively robust appearance and the great extent of the lung mischief. Since in such cases, too, intercurrent bronchitic and other attacks are often rapidly recovered from, the expression of a too unfavourable immediate prognosis, which the occurrence of one of these, coupled with the large extent of lung mischief, would seem to indicate, must be carefully guarded against. Mistakes of this kind often do much harm.

Cough in fibroid phthisis is always present, but when no active mischief is going on, and when the amount of disease is not great, it is slight, and accompanied with a correspondingly small amount of expectoration. In cases, however, where a large extent of lung is involved, and more especially if the disease is basal, *i.e.*, has spread from below, as after a catarrhal pneumonia or pleurisy, it is apt to be paroxysmal and very distressing, and to lead to vomiting. Its severity is then due probably to the physical difficulty in the way of getting the secretions expectorated. For reasons already mentioned, hæmorrhage in fibroid phthisis is common, and apt to be profuse and even fatal; and among other symptoms, the precise relationship of which to the fibroid process and phthisis generally will be discussed later on, are pains, rheumatic or pleuritic in character, anæmia, dyspnœa, chilliness, and clubbing of the fingers. Abnormal cardiac and vascular pulsation and murmurs, the results of displacement and traction, are also to be looked for.

With regard to complications, the risk of the fibroid

merging into the tubercular form is the most to be dreaded.*
Douglas Powell says that when the opposite lung becomes
involved, as indicated by a few permanent crepitations at the
apex, it is usually the result of tubercular deposit. Whether
this is or is not the case, I have had no accurate means of
judging, but the acceleration in the downward progress of the
case which implication of the hitherto sound lung usually
initiates, need not be ascribed to tubercle *per se.* As has been
discussed at p. 84, the mechanical conditions for cicatrisa-
tion are to a very large extent dependent on the disease
remaining unilateral, hence destruction of the tissue of the
sound lung from any cause must act specially injuriously.

The prognosis in fibroid phthisis is always a difficult
question. In a case, for example, where deepening of the
supraclavicular fossa, flattening of the upper chest, dragging
over of the opposite lung, dulness, obscure bronchial or
cavernous breathing, and scanty crackling crepitation, show
fibroid pneumonic phthisis, and where the entire absence of
fever and complications makes the immediate prognosis in
the highest degree favourable, how are we to form an idea of
the progress and ultimate termination of the case? A precise
answer to this question it is naturally impossible to obtain;
but the following may serve the purpose of indicating the
lines on which we should proceed in forming an opinion.

a. Extent and Locality of the Disease.—Complete healing of
a lung lesion being only possible if the surrounding parts can
yield to the extent of permitting cicatricial contraction, and
the yielding of these parts being limited, and more so above
than below, it follows that the ultimate prognosis can be
favourable only in cases where a small amount of lung is
involved. Where the lung is extensively affected, the prog-
nosis as regards duration is rather more favourable if the
mischief is basal.

b. Progress of the Disease.—The ultimate prognosis can

* Niemeyer, "Text Book of Practical Medicine," i., p. 237.

only be favourable if, after some six or eight months of appro-priate treatment, we find that the physical signs indicate some diminution in the extent of the disease. It is to be borne in mind that, in the lung, as in any other tissue, there occurs round an irritative focus, collateral inflammatory action, so that with any arrest in the progress of a phthisis, an im-provement in the percussion note and auscultatory signs is to be expected as a result of removal of inflammatory products from the surrounding air cells. In addition, this improvement will be rendered more apparent by the occurrence of com-pensatory emphysema. Should then, after the lapse of such a period, physical examination indicate an increase in the amount of mischief, and should this increase not be capable of being explained by some temporary or accidental cause, the ultimate prognosis is rendered more grave.

c. Condition of Patient.—The ultimate prognosis can only be favourable if the patient can be placed under favourable climatic and hygienic conditions. This is all the more the case if the patient's surroundings previously have been un-satisfactory, and what Pollock has said of phthisis generally, viz., that the more favourable the conditions under which it has shown itself the worse the prognosis, may be applied very specially to the fibroid type.

Taking into consideration, however, all these points, the prognosis must yet remain very uncertain. Cases have been reported in which a lung had been almost completely trans-formed into the fibroid state for twenty or twenty-five years, and I have at present, under observation, one similar case in which, under anything but favourable circumstances, this condition has existed for ten years. In this case the disease had begun in and spread from the lower lobe. Of apex cases in which, when first seen, the disease extended lower than the third rib in front, and in the physical signs of which subsequent examinations showed no improvement, I have had in the adult no example so favourable as regards duration.

Tubercular Phthisis.

Of this type in its most acute form the following is an example.

M., aet. 21, a clerk, was first seen in the beginning of March 1885. He stated that he had been feeling distinctly out of sorts for five or six weeks, that he had been losing flesh, breathless, hot at night, and had sweated a good deal since, that he had some pain in the left side, occasional pain in the stomach, and a cough. The cough, which he said had only come on lately, did not trouble him much except at night ; it was followed by a spit, which was mostly clear, and never showed blood. The pulse was 130 per minute, soft and compressible, the skin felt warm and moist ; and on examination of the chest, the physical signs were, a slight impairment of the percussion note over the left apex anteriorly and posteriorly, with a slightly cogwheel inspiration, and weakening of the entire respiratory murmur over the left infraclavicular region.

In spite of everything in the way of treatment being tried, this patient never showed the slightest sign of amelioration. Some five weeks afterwards, in consequence it was said of a chill, his voice became husky. His cough then became very distressing, his expectoration more profuse, greenish yellow and nummulated, and his breathlessness, feverish heat of skin, and sweatings more aggravated. On examining the chest the changes noted were, a distinctly high pitched percussion note over the left apex before and behind, and a slight impairment over the right apex posteriorly ; and on auscultation, the respiratory murmur over the left apex was bronchial in character, with coarse crepitation and increased vocal resonance, whilst over the right apex harsh breathing with a few crepitations were present.

The downward progress in this case steadily continued. In June, diarrhœa, to which, with severe abdominal pain, he had all through shown a tendency, became troublesome, and

as the weeks wore on, rapidly got worse, and increased his distress. Dyspnœa also increased, and rhonchi and crepitations gradually became more general over the chest. In the beginning of August, after a few days of aggravated suffering from breathlessness, death occurred.

On post-mortem examination, the left lung was found slightly adherent to the pleura at the apex, and on removing it, a cavity about the size of a walnut was opened into. On section, a large number of smaller cavities were found scattered through the upper lobe, and it could be seen that their number and size diminished on passing downwards. All over the section, but most easily recognised in the lower lobe, which was congested and œdematous, were scattered miliary tubercular nodules. The right lung was in a similar state, but to a much less extent; there was no apical adhesion, but a distinct puckering could be made out. The mucous membrane of the larynx was swollen, and ulceration existed at the base of the arytenoid cartilages, and at points also in the trachea. Ulceration was also found in connection with Peyer's patches in the intestines.

Such then are the characteristics of an acute tubercular phthisis. The recognition of such, even at an early stage, is comparatively easy, but it must be borne in mind that symptoms in this respect are of greater value than physical signs. The fever, breathlessness, pallor, and rapid wasting are typical, and although the patient may have no idea that his illness is such a serious one, he is in this form of phthisis depressed and often irritable. The cough is short, and at first clear bronchial mucus is expectorated, later on the sputum becomes yellow, at first in streaks, later on in its entirety. Hæmorrhage is uncommon; if it does occur, it is usually slight. Complications, as laryngeal and intestinal tubercle and fistula, are common.

Early in the disease the physical signs of mischief are at times almost absolutely wanting. Usually, however, a slight

rise in the pitch of the percussion note at an apex, anteriorly or posteriorly, may be detected, and with this will be associated, on auscultation, one or other of the following :— prolongation and harshness of the expiratory murmur, harsh- ness of the inspiration, inspiratory jerking or cogwheel rhythm, or a weakening of the whole respiratory murmur. A little fine crepitation may be made out after a cough, but this sign is often wanting in the early stage. Later on the signs of consolidation, softening, and excavation become easily re- cognisable, and the opposite lung is soon involved. As a whole, however, the physical signs, especially to percussion, are not so marked as in the pneumonic and fibroid types. The duration is about five months.

Although the tubercular form of phthisis is always most grave, its downward course is happily not always so uniform as in the example just given. A chronic form can be recognised, which, unlike the acute, exhibits efforts at arrest. Though usually, as Powell says, fatal within two years, it may last a much longer time, and in favourable circumstances may even heal.

Of such it is unnecessary to give a detailed example. Its symptoms and course are very similar to those of a pneu- monic phthisis, from which indeed it is often difficult to dis- tinguish it. To aid in the differentiation, the following points should be attended to :—

In the tubercular form there is a greater probability of there being a hereditary or innate tendency to phthisis, and its occurrence is usually at an earlier age. The patient will also give a history of indisposition before the cough began, that is to say, the onset of the mischief cannot so distinctly be traced to a cold. The nature of this preceding ailing is often indefinite. It may be simply that he has felt listless, easily tired, and not so fit for work ; or that he has been affected with gastric or intestinal pain, transient diarrhœa, or fistula. Pains in the chest caused by pleuritic attacks are common in

the early stage, and indeed also in the course of the malady, and huskiness of voice and aphonia stand out prominently in a similar relation to it.   Not unfrequently the history is that, after feeling generally out of sorts for some weeks or months, a hæmoptysis is the first symptom for which relief is sought. The patient further is anæmic, and appears depressed ; the pulse is often soft and extremely rapid.   The fever, however, of chronic tubercular phthisis differs from that of the pneumonic, in that whilst in the latter its diminution indicates a corresponding modification in the severity of the disease and improvement in the condition of the patient, such a fortunate association is not so certain in the former.   Indeed, one sees cases of tubercular phthisis in which, although fever and cough, hectic and sweatings, may be lessened for a week or so at a time, evidence of continuation of the morbid process in the lung, and, although perhaps to a less extent of corresponding impairment in the general conditions, can readily be demonstrated.   This can be explained from the point of view of the pathology, for whilst in the pneumonic form there are changes in the air cells and small bronchi which are obviously inflammatory in nature, in the tubercular the essential process consists in a deposit or infiltration.   Of course in the tubercular cases some inflammatory change is almost certain to be taking place in the parts around, and when the tubercular foci have softened, and their liquefied contents are being got rid of by expectoration, this addition is most likely to occur.   Remembering, however, that by the type we mean to designate only the process which is predominant, the statement that fever must necessarily accompany active disease in the pneumonic, and need not do so in the chronic tubercular, holds good.   This will be more fully considered in treating in detail of the symptoms later on.

The physical signs of the chronic tubercular form are usually somewhat obscure in the early stage, but are afterwards definite enough.   At first the impairment of the per-

cussion note at apex or base may be but slight, and associated with a harshening or weakening of the respiratory murmur there may be a few dry sounding crepitations. Later on it is different. As Powell says, "the percussion note becomes hardened, and we may be surprised by the appearance (having omitted to examine the patient for a week or two) of some feeble blowing respirations, of hollow quality, still very dry, which increases in the same obscure way until an unmistakeable cavity is present. This formation of a cavity by a process of dry crumbling is very characteristic of the typical form of pulmonary tuberculisation." A cavity having formed, an amelioration in the patient's condition may occur. This may be so marked as to constitute an arrest, but usually any improvement is not of long duration. Other foci almost certainly exist in the same lung, or in the opposite one, for we know that, in differentiating the tubercular form of the disease, the early implication of both organs is very important.

Another aspect of the tubercular form of the disease is its supervention upon the more chronic cases of the pneumonic or fibroid phthisis. To such it very often acts as the termination, and although it may occur in these circumstances acutely, that is to say, resembling the acute variety of the tubercular form, its onset is apt to be insidious and difficult to recognise. At first all that may awake a suspicion is a more or less rapid falling off in the patient's general condition, his appetite has become more impaired, his pulse is a little more rapid, and distinctly softer and more compressible than before, and his temperature shows less of a tendency to remit. Or it may be that he complains a little more of his cough or of dyspnœa, and on examining the chest some crepitation can be detected at the apex of the hitherto sound lung. At other times, however, even from the first, the voice becoming hoarse or aphonic, the cough greatly aggravated, the dyspnœa more intense, the occurrence of a diarrhœa which resists all treatment, or the supervention of fistula, render its diagnosis easy.

CHAPTER VI.

SYMPTOMS AND SYMPTOMATIC TREATMENT OF PHTHISIS.

As a symptom of phthisis, cough stands out the most prominent of all, and the doleful statement that, once present, it continues to the end, is one to which, although some reservation may be made, no exception can in its general sense be taken.

As with other reflex acts, cough is for a purpose, but, as with other of nature's doings, although its main effect is beneficial in nature, its performance is necessarily attended with secondary effects, which are more or less injurious. Thus, while primarily its function is to rid the organism of some irritating material, usually in the form of noxious liquefied catarrhal pneumonic or tubercular products, it is apt, secondarily, as was shown in Chapter III., either to impede subsequent healing by distending forcibly the cavity or cavities thus formed, or to extend the mischief by driving these noxious matters to other parts of the respiratory organs. In considering the cough of phthisis, we have therefore to remember that such results are liable to be brought about, and that consequently, if our efforts at its treatment are to be successful, we must thoroughly understand everything connected with its cause and mechanism, so to be able to take full advantage of its good effects, and at the same time reduce the operation of the injurious ones to the lowest possible limit.

In health, the respiratory mucous membrane is covered by a thin layer of mucus. Like other fluids and solids

of the body, this is constantly being renewed, its place being taken by new formed secretion. Under normal conditions, this waste and renewal takes place very slowly, and more or less insensibly, the older mucus being either carried away as part of the organic matter of the breath in expiration, or having been driven by the action of the ciliated epithelium to the larynx, it there acts as a stimulus, and the more or less involuntary act of clearing the throat taking place, it is removed thence to the pharynx, and probably swallowed. Indeed, it might be said that the last mentioned process of removal is required only when the secretion is increased in quantity above the normal, were it not that, as the result of constant changes in the temperature, humidity, &c., of the atmosphere breathed, very considerable variations must occur in the activity of the secretion process under what we recognise as perfectly normal circumstances. As further indicating, however, that in health the secretion process is very slow, it would seem that the presence of a normal thin layer of mucus inhibits the formation of more by protecting the underlying glands from the effects of cold or other irritating agents.

Cough occurs when the ordinary secretion is so increased in quantity as to act as an irritant, or when some irritating material from within the lung, as from a caseating mass, or from without, as dust particles, comes in contact with the mucous membrane. It is necessary, however, to notice that, in connection with the production of the reflex act of coughing, all parts of the respiratory tract are not equally irritable. On this point many experiments have been made by Kiemer, Kohts, and others, and it has been shewn that the larynx is specially irritable, the bifurcation of the trachea less so, the tracheal and bronchial walls elsewhere than at the bifurcation still less, and the lung alveoli themselves not at all. Moreover, it has also been demonstrated in animals, that irritation applied to the pharynx, œsophagus, and pleura will induce

cough ; and we have in addition to bear in mind, that stimuli applied to parts still more remote, may have a like effect, as evidenced by the occurrence of ear cough and stomach cough. Bearing these theoretical considerations in mind, the various aspects of the cough in phthisis can be best understood.

The severity of the cough in phthisis may be said in a general way to correspond with the course of the disease, progressing as this extends, subsiding as it declines or becomes arrested, and increasing in severity with every fresh start or acceleration in its progress. To this general statement, however, some important qualifications must be made. Thus, as has been already remarked in the early stage of the tubercular form of phthisis, cough is not unfrequently very slight. Indeed, it may be said, at all events by the patient himself, to be entirely wanting, its place being taken perhaps by a tickling sensation in the larynx. So much is this the case, that if we find that a patient has been pale, emaciated, and feverish for some time, we shall always act most safely if we do not attach much importance to his statement about the cough, but trust to other symptoms, and to physical examination. The relative insignificance of cough as a symptom may be explained on the theory that the lesion in a tubercular case involves for the most part the fibrous tissue of the alveolar or bronchial walls, and thus induces little or none of the bronchial catarrh on which the existence of the cough depends. Similarly, during the course of a tubercular phthisis, we may be suprised to find the cough and expectoration almost entirely disappearing for a week or two at a time, and yet the patient's general condition going on from bad to worse. Such conditions not unusually arise with the onset of complications, intestinal, renal, &c., and may be due to these producing a derivative effect on the bronchial catarrh, but the above explanation, corroborated by the observation that the lung mischief is still extending, will here also hold good.

Pneumonic phthisis, fibroid phthisis, and the great majority of the tubercular forms of the disease, have associated with them bronchial catarrh, and therefore present cough as the most prominent symptom from the very commencement ; and the importance of cough as an early symptom in connection with the diagnosis of the pneumonic from the tubercular form, has been already alluded to.

If we inquire of any patient as to where the sensation which immediately gives rise to cough is felt, the larynx, or the part of the tube extending from it to the tracheal bifurcation, is in most cases pointed out. This is due to the extra sensibility of these parts, as evidenced by the results of the experiments on animals before mentioned, and by the fact that in laryngeal phthisis the cough is especially distressing. Similarly, from these experiments, we can understand how a congested and irritable state of the fauces and pharynx may give rise, as Pollock has remarked, to a dry, frequent, and irritating cough, and how in the course of phthisis a pleurisy may aggravate this symptom.

The readiness with which the matter to be expectorated can be got rid of influences the severity of the cough. In early phthisis it may be very irritating, because the secretion, small in amount and thick in consistence, cannot easily be displaced by the respiratory effort, a condition which is often ameliorated as the disease progresses, the patient then says the cough is looser. In advanced cases often of the fibrous type, where extensive lung mischief, cavities, and dilated tubes are existent, and where the expiratory blast cannot readily be made to affect the position of the secretion, the cough is very violent and paroxysmal, and usually leads to vomiting. For obvious reasons, the most striking examples of this are found among basal phthises.

The position of the patient can exercise an influence on the occurrence of cough, and in this connection two kinds, a cough which occurs on lying down, and a cough which occurs after

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sleep, can easily be recognised. The first kind, the cough which occurs on lying down, has had several explanations. One is, that in a horizontal position the upper parts of the lungs, that is to say, the parts mostly affected, will, through gravity, receive a larger supply of blood, and that consequently secretion will be increased ; and this consideration may further serve to explain the difficulty which many phthisical patients experience, when they lie on the affected side. It is possible also, that in such circumstances the difficulty which the ciliated epithelium will have to meet in its function of removing the secretion, may cause its collection in certain localities in such quantity as to excite cough. But probably a more important factor in the production of the lying down cough is a nervous one. Thus experiments show that the excitability of the respiratory centre is greatly influenced by the condition of the blood circulating through it. A stimulus applied to the vagus sufficient, under ordinary conditions, to produce only respiratory quickening, will, if the animal be rendered apnœic, have no effect at all, and if dyspnœic, will produce general convulsions. Inasmuch then as, in the prone position, the respiratory function is not so well performed, the respiratory centre will, so long as the patient is awake, be rendered to a corresponding extent more irritable, and consequently will be excited so as to produce cough by an amount of secretion which, in the upright position, would not have had this effect. The cough which occurs in the morning, or which wakens the patient at longer or shorter intervals during the night, has another explanation. During sleep the irritability of the respiratory, like that of other reflex centres, is in abeyance, and consequently an amount of secretion, which under ordinary circumstances would serve to stimulate it, fails to do so. It consequently goes on accumulating till its quantity is sufficient to irritate the centre, it then induces cough, and the patient is awakened. For similar reasons, the awakening of a phthisical patient by

any external means is often followed by a fit of coughing, the secretion, which has been collecting, then sufficing to irritate the more excitable respiratory centre.

Cough when severe is apt to be followed by vomiting, the explanation of which is the close association of the respiratory and vomiting centres in the medulla; and conversely it is to be remembered that, through this association of respiratory and gastric centres, the taking of food frequently aggravates the cough.

Finally, there is no doubt that the condition of the central nervous system materially influences its occurrence. In individuals of an excitable, nervous temperament, in young adults and adolescents, it is apt to be specially troublesome, and in such, periodical aggravation of the cough may even occur without any corresponding aggravation of the disease. Conversely in the phthisis of the aged it is often less marked, and in lunatics the absence of cough, as of the other symptoms of phthisis, stands forth prominently. We may further suppose that it is, in part at least, through a similar influence of the central nervous system, induced, however, reflexly, that the supervention of complications so frequently tends to induce a diminution in its severity.

From such considerations we can easily understand how marked are the differences in the severity of the cough in different cases: how in one patient there may be extensive disease, and yet at times cough can hardly be said to exist, the unconsciously performed act of clearing the throat doing all that is required; how in another the disease may run its course with a comparatively trifling cough, up to the fatal issue; and how, in a third, the cough may be all through the most distressing of the symptoms.

The directions in which our efforts at its treatment should be made have now to be considered. In the first place, it will be understood that where it is not very troublesome, and where it is easily followed by expectoration, its beneficial

effects are at a maximum, and direct attempts to stop it
would be injurious. Under this head may be included the
morning cough, and the cough which awakens the patient now
and again during the night, if such awakenings are not so
frequent as to interfere with rest and sleep. In these circum-
stances cough mixtures are not required. The patient should
be advised to talk as little and avoid coughing as much as
possible during the day, and during the night or in the
morning a little milk or warm tea will often serve to promote
the required riddance by expectoration, with the minimum of
harm as the result of the mechanical effect of the coughing.
Similarly the cough which occurs on lying down may be
ameliorated by getting the patient to sleep supported as in
cardiac cases on a bed rest.

Unfortunately, however, favourable conditions like these
are but seldom met with. We have usually before us a cough
which, in consequence of the too copious secretion from cavities
or bronchial walls, of difficulty of expectoration, of increased
reflex irritability, or of all these combined, is frequent, severe,
irritating, and mechanically injurious. Medical treatment
then becomes imperative, and although in the majority of
cases endeavours to diminish secretion, promote expectora-
tion, and allay nervous irritability, will have to proceed side
by side, there is no doubt that of all these the last is the
one, treatment of which is most uniformly demanded. Nature
is prone to run to extremes, hence cough is usually in excess
of its requirements. For the ordinary phthisical cough there-
fore sedatives are almost always required, and of these hydro-
cyanic acid, combined with a tonic as in Begbie's mixture, or
with morphia or iodide of potassium, is probably the one
most frequently prescribed. Opium and morphia in various
forms will in most cases sooner or later be required; they
should, however, be given carefully in the early stage, kept in
reserve as it were for the later. Their tendency to interfere
with appetite and digestion, to cause headache, and to increase

the sweating, may be mitigated by the addition of camphor, as in the tinct. camph. co., or ipecacuanha, as in Dover's powder; and to this end also a glass of lemonade or a cup of coffee in the morning, as recommended by Pollock, will often be found useful. Where opiates do not agree, or when it is considered desirable to avoid them, chloral, cannabis indica, aconite, or codeia, may be used; and among the laity such preparations as Powell's Balsam, Congreve's Elixir, and Chlorodyne are much in vogue. In many cases remedies of the demulcent kind are useful, and of these cetraria is perhaps the one most used.

But the treatment of the phthisical cough can often be well carried out by inhalation. When it is the result of secretion, excessive in amount or irritating in nature, the advantage of this method will be obvious; but apart from this the ordinary phthisical cough which requires sedation may be relieved in this way. For its application the steam-inhaler, with such remedies as the extract of conium and the extract of lupulus, or the spray-producer, with cocaine, may be used. Inasmuch, further, as the so-called spasmodic element enters largely into the production of the cough, the cures recommended for spasmodic asthma, as Himrod's powder, may be tried.

Where the cough is distinctly the result of excessive and irritating secretion, the antiseptic remedies, iodoform, creosote, &c., are the best. They may be administered internally or by inhalation in the manner described further on. (Page 152.)

A dry, frequent, and irritating cough may depend on an irritable condition of the pharynx and fauces. In the majority of cases of chronic phthisis, these parts, and notably also the soft palate, appear pale, bloodless, and dry looking, with a few deeply coloured vessels coursing here and there. In certain cases, however, they are somewhat swollen and congested, in which circumstances the use of local astringents may help to alleviate the cough.

In laryngeal phthisis, or in the hyperæmic and swollen

condition of that organ which is often found in pulmonary phthisis, the cough is very distressing, and, of course, correspondingly dry.   Remedies recommended for the treatment of laryngeal phthisis are then applicable.

In rapidly·failing cases, where the cough is constant and irritating, and completely prevents sleep, and where physical examination and the continuously high temperature indicate that rapid spread of the lung mischief is going on, I have again and again seen short periods of most welcome rest obtained by the application of a large fomentation or poultice to the front or back of the chest ; and in less severe cases of the same kind the application of a mustard leaf or a piece of spongio-piline, rendered stimulating by diluted nitric acid (1 to 20 of water), has had a similarly good effect.   When pleurisy is present, and is adding to the patient's distress, relief is best obtained by counter irritation (a small fly blister) and the application of a flannel bandage, to diminish as far as possible the irritation consequent on movement of the pulmonary on the costal pleura.

Where the irritable condition of the respiratory centre has extended to the gastric one, and consequently where a severe coughing fit is followed by vomiting, or where the taking of food brings on coughing and frequent vomiting in its train, hydrocyanic acid, morphia, or other sedatives, are of course indicated.   With these however, much good may further be obtained by carefully arranging to keep the food as dry, that is to say, with as little fluid as possible.   Alcoholic stimulants are then distinctly beneficial, they may be given before food ; and as an adjuvant a mustard plaster over the epigastrium may be of service.

Fever.—Progressive destruction of the lung with progressive wasting of the body being the main changes from the normal which the study of consumption reveals, we may look upon the fever as a symptom bearing a somewhat similar general relationship to changes in the body as does the cough to

changes in the lung. It is through the cough that the lung
gets rid of those portions of itself which, diseased and irritating,
it is necessary for it to yield ; it is mainly through the fever that
the wasting representative of the encroachment on its capital,
that it is necessary for the body to make, is brought about.

We have seen that the cough of phthisis presents two
aspects in connection with the disease, one salutary, the
other injurious. The fever may be similarly viewed, but
before considering this, we must endeavour to understand
something of its causation in phthisis.

The temperature chart of a phthisical patient is in the
great majority of cases peculiarly irregular. It may present
high and low maxima, high and low minima, high evening
and low morning temperatures, and the converse of this,
normal temperatures and sub-normal temperatures, and any
of these may be found existing for a few days or even for
weeks together. This is what is to be expected in a malady
in which arrests more or less complete, remissions, exacerba-
tions, and complications are so common, and indicates that
no very definite conclusions can be drawn as regards the
course of the temperature in this disease. Nevertheless, in it
two types of fever are to be looked for, and although they are
usually so intermingled that a diagnosis of the one as dis-
tinguished from the other cannot clearly be made, the re-
cognition of either, as predominating, should always be
attempted, as affording data of great value from a diagnostic
and therapeutical point of view. These two types are the
Inflammatory and the Resorptive.

The *Inflammatory* fever, which, as its name denotes, is the
result of irritative and inflammatory process taking place in
the lung, is recognised by its presenting a more or less
constant heightening of the temperature and quickening of
the pulse, with a uniformly dry skin and feeling of heat. It
may be compared to the fastigium of a croupous pneumonia,
where the difference between the morning and evening

temperatures is very slight. A discussion on the causation of fever would be here out of place, but we may suppose that this inflammatory form is due in part to local increase of heat production raising the temperature of the body generally through the circulation, in part to the central nervous system producing increased calorific changes as the result of this local irritation, and in part to the balance between heat production and heat expenditure being disturbed, in favour of the former.

The *Resorptive* fever, on the other hand, which is due to resorption from caseating and softened catarrhal pneumonic or tubercular masses in the lung, of material more or less septic in character, is recognised by its shewing marked fluctuations, and is associated with shiverings and sweatings. It may be compared to the fever of pyæmia or of remittent fever. In it the differences between the morning and evening temperatures are great, and although with it, as with the inflammatory form, the precise causation is unknown, it may be supposed to be a manifestation of the efforts made by the organism to react against absorbed septic matters.

These, then, are the types of fever found in phthisis, they are always to be looked for, but as already stated, and as explained by the complex pathological phenomena, a mixture of the two is always to be expected.

The intensity of the fever varies much in different cases. In those examples of galloping pneumonic or tubercular phthisis, in which rapid extension of lung mischief takes place, and which run their course in a few months, maxima of 104° F. or over, are met with with minima of 101° or 102°, whilst in more chronic cases, maxima of 101° or 102° are common with normal or subnormal temperatures as minima. In still more chronic cases, intervals may occur where the maximum temperature does not reach 100°, and in arrests, the temperature will of course be normal. In arrests or intervals, however, as indeed in all circumstances where the health

is below par, a tendency to mobility of the temperature is characteristic ("a curve shewing isolated and apparently causeless elevations,"—Wunderlich), and this mobility, associated as it usually is with corresponding variability in the pulse rate, is always to be viewed with suspicion.

In all forms of phthisis, the evening temperatures are usually the higher; exceptionally, however, they may be of the same height or lower than the morning ones. In the former case, that is to say, where the evening and morning temperatures are alike, we are apt, if the temperature has been taken only twice in the twenty-four hours, to suppose that fluctuations have not been occurring. By taking the temperature at shorter intervals, we shall, however, almost certainly find their presence revealed. Similarly, in those cases when the evening are lower than the morning temperatures, "inverse temperatures," more frequent thermometric observations will reveal fluctuations in the intervals. In all those cases where the evening temperatures are persistently either of the same height or lower than the morning ones, the previous habits and mode of life of the patients may be looked to for an explanation ; it may be found, for example, that their occupation has for some time previously necessitated working by night and resting by day, as in night policemen and night nurses.

The effect of the complications of phthisis on the fever requires notice. Such as are of an inflammatory nature, as pleuritic, pneumonic, or peritonic attacks, will raise it ; but others, such for example as the supervention of intestinal or laryngeal phthisis, may not only have no effect in this way, but may even seem to diminish it. In three cases of tubercular phthisis which I had under my care, I noted that during attacks of acute nephritis, the temperature fell to the normal, rising again on the subsidence of the renal mischief. This abatement of the fever was associated with a corresponding alleviation of the pulmonary symptoms, and may perhaps be

regarded as being explained by the law put forward by
Pollock, that in tubercle, " every agent capable of converting
it from its usual course adds prolongation to its time."
Further, distinct lowering of the temperature will be produced
by hæmorrhage or collapse after pneumothorax or intestinal
perforation.   Apart from complications also, a period of
comparative collapse precedes death in most cases of phthisis,
and this is of course associated with a lowered temperature.

Can extension of lung mischief in phthisis occur without
causing fever, and rise of temperature?   This is a question which
has been already alluded to (p. 144), and which is discussed
by Woodman, in his translation of Wunderlich's Medical
Thermometry, and answered in the affirmative.   Woodman
quotes M. Henri Roger as follows :—" Although both in
infancy and at more advanced periods of life tubercles some-
times cause an increase of temperature, they do not do so on
their own account, but only by the effects which they produce,
and by the local irritation caused by their presence in the
tissues.   When the inflammation is wanting, or if it becomes
chronic, the thermometer will scarcely rise above the average
level."   Inasmuch, however, as tubercular deposit in the lung
is very seldom unassociated causally with pulmonary irritation
and inflammation, and as in a certain proportion of phthisical
cases the mischief is almost entirely inflammatory, absence of
fever will be very rare.   It doubtless, however, may occur, and
in the cases of phthisis previously alluded to, in which acute
renal complications supervened, increase in the extent of the
lung mischief seemed to go on although the temperature was
rather subnormal.

Fever, with its bodily waste and other results to the
organism, might seem at first sight to be entirely injurious,
but as with the other symptoms and physical changes in
phthisis, it is not impossible that salutary aspects in it and
in its results may be recognised.   To understand this, our
acquaintance with the phenomena of fever as a whole would

require to be much more intimate than it is, but in the absence of such exact knowledge a general consideration of the subject seems to point to such a conclusion. Thus, there can be little doubt that in the so called cardinal symptoms of inflammation, pain, heat, redness and swelling, as manifested by a part in response to local irritation, and in the more or less febrile state which it induces, there can be recognised efforts more or less salutary in nature. In the case, for example, of a thorn penetrating the epidermis and entering the true skin, we cannot but believe that the irritation produced by its effects locally and on the system generally, by causing rapid proliferation of the epidermal cells, will lead to its removal more rapidly than had no such irritation occurred. In phthisis such a salutary effect in the case of the local irritation cannot perhaps be so conclusively demonstrated, but we are not altogether wrong in our interpretation of the phenomena of this disease if we believe that both the inflammatory and resorptive fevers indicate reaction, the former leading to the liquefaction, separation, or encapsulation of catarrhal pneumonic or tubercular products ; the latter leading to the destruction or elimination of septic products which have found their way into the blood, or at least tending to the mitigation of their evil effects.

Emaciation.—With the fever of phthisis loss of weight is so closely associated, that to a large extent these may be viewed in the relationship of cause and effect ; and the action of the fever in this respect is a double one : it increases bodily waste, and by provoking anorexia and interfering with digestion, it impairs the supply. Other conditions, however, are concerned in its causation, but these will be better understood after the general subject of loss of weight or emaciation has been considered.

In consumption, loss of weight occurs in many cases long · before pulmonary symptoms have shown themselves ; in all it is at least noticed from the very beginning of the disease, and to such an extent is this the case, that wasting of the

body is by the laity looked upon as the surest indication of pulmonary disease. It diminishes or ceases during remissions or arrests ; in the latter circumstances, weight may even be gained, and if such a patient again begins to lose weight, a fresh start of the lung mischief may be predicted.

The extent to which loss of weight occurs in phthisis can very seldom be correctly ascertained, as a knowledge of it would necessitate an exact acquaintance with the patient's weight previous to the commencement of the illness, as well as the weight at death. It would seem, however, that it may reach one third or one fourth of the initial weight. This approaches very closely to the extent of loss of weight in animals starved to death (four-tenths), and as in starvation, although the fat is the one tissue mainly used up, all the rest, including the blood, are to a greater or less extent consumed.* That this correspondence between the emaciation of phthisis and of starvation should be so close, is extremely interesting, as indicating to how great an extent the fatal termination in phthisis is due to simple exhaustion. The fact, however, that it does not quite equal it even in extreme cases, and that in a certain proportion death occurs before such a degree of emaciation is reached, can be quite easily understood, when it is remembered that the pulmonary visceral or cerebral complications of the phthisical processes so apt to occur, may tilt the balance over before all the available capital has been expended.

The cause of the loss of weight is mainly the fever, as has been already indicated, acting directly by increasing bodily waste, and indirectly by interfering with appetite and digestive power. But there are other causes. Thus, the emaciation makes rapid strides when diarrhœa occurs, and that the supervention of disease in the organs concerned in absorption, as the lacteal glands and liver, must accelerate this process,

* To this the blood glands, notably the liver, often form however distinct exceptions. See p. 190.

can be easily understood. Repeated hæmorrhages too will have a similar effect.

But, as has been already mentioned, in the pre-phthisical stage, that is to say, before any distinct symptoms or signs of lung mischief have shewn themselves, the patient or his friends are frequently conscious that a loss of flesh has been occurring, and that with this there has been associated the feeling of less fitness for work than usual. Apart from slight feverishness, caused by lung mischief actually present, though not revealing itself by symptoms, nor detectable by physical examination, it may be supposed that we have here an example of that condition which we vaguely term depressed nutritive power. Brought on by confinement, over-work, mental worry, acute disease, or accident, we frequently see these terminate in phthisis.

Can loss of weight present a salutary aspect? On this subject Pollock writes as follows :—" The reduction of the solids of the body, the emaciation, muscular waste, and absorption of fat are necessary in order to establish a balance between the system as a whole, and the organs which are to supply it. In any diminution of respiratory space caused by inflammatory attacks on the lung, bronchi, or pleura, an immediate reduction of the respiratory requirements of the body becomes a necessity, and is accomplished by the waste consequent on fever and by secretion." And again, " a condition of moderate emaciation seems essential to the long continuance of the tubercular disease."

That a certain amount of weight may be of benefit is apparent, when we remember that heavy persons, if they are to maintain their weight, must eat, digest, assimilate, and decompose more than spare individuals under analogous conditions, and that consequently for the metabolic processes of such, a greater expenditure of energy is required.* Practically, however, in phthisis loss of weight is to be regarded

* Landois and Stirling's Physiology, i., p. 519.

as uniformly unfavourable, the improved nutritive power indicated by gain in weight, rendering the increase in the amount of energy required to be expended in the daily metabolism of no importance.   Further, the increase in the amount of subcutaneous fat, directly by diminishing the loss of heat, and indirectly by permitting more freedom in the taking of open air exercise, is unexceptionally beneficial.   The interpretation of loss of weight, however, as a symptom of phthisis, would not have been complete if this possibly salutary aspect in it, pointed out by Pollock, had not been referred to.

Perspirations.—Associated with the fever of phthisis, the perspirations are to be considered.   Sweating may occur at any period in the disease, or may precede its active manifestation, but usually it shews itself at the more advanced stages. In its profuseness, intermissions and remissions may shew themselves from time to time, and now and again it may completely disappear, although the disease goes on in its course unchecked.   When slight, the head, neck, and chest are alone affected ; when severe, the entire surface of the body is involved.   As regards time, it is of course commonest at night and in the early morning, and sleep has certainly an important influence on its production.   Thus during the night the deeper the sleep, the more the sweat, and when a consumptive falls asleep during the day, he is apt to awake with his face and neck bathed in perspiration.   The influence of severe paroxysms of coughing in provoking perspiration can often be remarked, and if with these vomiting is associated, the diaphoresis is still greater.

Although, as stated by many observers, sweating may occur without fever, a distinct relationship between these two can almost always be observed.   This is best seen if the daily curve or temperature be looked at in a case where resorptive fever is present, and in such a primary stage of shivering, or at least chilliness, and a secondary one of high

temperature, will usually be noted to precede the perspiration. When, on the other hand, the temperature remains persistently high, as in the inflammatory form, perspirations are usually absent. This leads to the consideration of the signification of the phthisical sweating.

Phthisical sweats are injurious, as, apart from the irritation and discomfort which they cause, they indicate a loss of energy to the body in the form of heat, and perhaps also because they entail the expenditure, in the secretion processes of the skin, of an energy which the body can ill spare. In them, however, again a salutary aspect can easily be discerned. Thus, just as in ague or croupous pneumonia, the fever may be regarded as being due to the increased metabolism required to militate against the disease germs which have managed to obtain an entrance into the body, and the subsequent sweating to represent the means by which, those germs having been overcome, the bodily temperature is reduced, so it may be with phthisis. Further, as has been stated by Pollock, in the sweats we may recognise efforts to throw off morbid material from the blood, and we may look upon them as " representing vicariously (to the lungs) the exhalation of watery matter from the system." But the observations, that sweating is most prone to occur during the night, that then the deeper the sleep the greater is the sweating, and that a consumptive sleeping during the day is apt to perspire, require further explanation. Such is not readily forthcoming, but practically all this may be looked upon in a general way as shewing a tendency to perspiration at times when the vital energies are at their lowest.

While therefore we recognise that, as a means of lowering heightened temperature, and of eliminating morbid material from the body, sweating may be to some extent directly beneficial, we must also admit, that occurring as it may, independently of these processes, or to a degree in excess of what the performance of them requires, it will be directly more injurious.

This is in part the reason why in phthisis we fail to see benefit following the sweating, as in ague or in the critical sweats of a pneumonia. To a much greater extent, however, this difference is due to the fact that, as it is well evidenced in the hectic and sweating of resorptive fever, no sooner has the body responded to the call for the increased metabolism to enable it to react against, or perhaps eliminate one set of morbid germs, absorbed from softened mass or cavity, than a fresh set are resorbed, and demand a similar response. The sweats of phthisis may be aptly compared to those of septicæmia, in which no escape for the septic matter can be obtained.

An attempt may be made here to answer the question as to how in individuals predisposed to phthisis, but in whom actual disease in the lungs is assuredly non-existent, a marked tendency to perspiration should often be observed. Here resorption of morbid products is out of the question, but we may suppose that, along with that which we vaguely term deficient vitality, there is that instability which is often a forerunner of the disease. Such individuals shew great variation in the pulse rate with the slightest exertion, their faces flush with the slightest excitement, and they are sensitive to the slightest changes in temperature. A similar irritability affects their heat regulating mechanism, and thus temperature fluctuations and sweatings, apparently causeless, are continually shewing themselves.

We have seen that the fever in phthisis may be in part salutary, and in part injurious,—salutary, as indicating efforts to choke off nutrition around a caseous mass, and so hasten softening, and promote ejection, and by stimulating growth of fibrous tissue, to promote encapsulation (inflammatory fever), or as indicating efforts at reaction against morbid germs, absorbed from softened mass or cavity, and so to tend to their destruction or elimination (resorptive fever) ; injurious, as being in excess of its requirements, and impairing general nutrition by increas-

ing bodily waste and interfering with appetite and digestion. Remembering now the extraordinary complexity of the conditions in the lung, that an inflammatory process which is useful at one part may be injurious at another, that an irritative fibrosis may be at once a protection and a cause of further irritation, and that the state of fever, while of use to the system generally, may be harmful to the disease locally, we can understand how difficult it is to interpret fully its manifestations, and to decide upon its treatment.

Where the inflammatory fever, as evidenced by the more or less continuously high temperature, pain, thirst, &c., seems to be the condition requiring most care, rest, as far as it can be got, is required. The patient should be kept in his room, perhaps in bed; care should be taken that the air is pure and of a uniform temperature; sedatives should be used to quiet the cough, and hot fomentations or poultices applied to the chest. Stimulants should be discontinued as a rule, a simple alkaline mixture may be administered, and if the bowels are confined, or the tongue foul, the rhubarb and soda powder will often be found useful.

For the resorption fever, the indication is of course to use drugs having an antiseptic action. Foremost amongst these is quinine, which, in the form of Heim's pill,* is in other ways beneficial in phthisis, and is perhaps the most used and the most useful of remedies. Next, probably in order of value, is iodoform,† and it may be used also in pill as advised by

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* Quiniae Sulph., grs. 20.
  Pulv. Digital. grs. 10.
  Pulv. Ipecac.
  Pulv. Opii, a a grs. v.
           M.
  Ft. mas. div. in pil., 20.
       Sig.   One twice daily.
† Iodoformi, gr. 1½.
  Croton. Chloral. Hydrat. gr. ii.
           M.
  Ft. pil.
       Sig.   One thrice daily.
           L

Ransome in the *British Medical Journal* for January 5th, 1884. Creosote may also be found useful, in drop doses twice daily, in pill, or as Jaccoud recommends, with glycerine and a drop of oil of peppermint, or with brandy. It is apt to cause gastralgia, probably least so in the pill form. In addition, terebene, menthol, thymol, salicylic acid, the salicylates and the sulpho-carbolates have also been tried.

The effects of antiseptic remedies can often be obtained by inhalation in the form of spray, or by one or other of the various forms of respirators, and creosote, eucalyptus, terebene, and thymol can fitly be made use of in this way.

Such then are the general remedial measures for the treatment of the fevers of phthisis. It is to be remembered that, as these fevers are always of a more or less mixed form, the indications for the special use of either set are usually anything but clear. However carefully we may diagnose, we shall every now and then find cases of the so-called inflammatory fever benefited by antiseptic remedies, or cases presenting mainly resorptive fever improved by rest and inflammatory fever treatment; and though it cannot well be explained, it is equally common to find a case in which one antiseptic has seemed to fail utterly, and another has been a brilliant success. Again, in the treatment, especially of the inflammatory form of fever, it is difficult to decide to what extent remaining in bed or indoors should be insisted on, for enforced rest to the lung tissues may be as injurious at one time as it is useful at another. In such circumstances a lessening of the temperature as a whole, a more distinctly remittent type of fever, that is to say, a more distinct difference between the morning and evening temperatures, may help us, and the patient's inclination is always a good guide. Though the fever be high, if he feels inclined to go about, we should be very chary about preventing him, for when once a phthisical patient is kept off his legs his downward progress is apt to be very rapid.

The perspirations of phthisis being mainly the result of fever in general, and of the resorption form of it in particular, their treatment is usually comprised in that of the fever. Thus, where with preliminary shiverings or chilliness, and heat of skin, it seems distinctly due to resorption, the antiseptics are of most use, and Heim's pill, iodoform, creosote, &c., will often be found useful in alleviating it. But in cases where these fail to act, either because their antiseptic powers are not equal to the occasion, or because the perspiration seems to be due to some other cause, more direct treatment is required, and most varied plans have been advocated to this end. Feeding the patient during the night is one which is always tried in bad cases, on the principle that sweatings are to a large extent the result of exhaustion ; and milk, soups, or beef tea, coffee, cold tea, and alcohol are the articles out of which a choice may be made.

Inunction of the skin with oil seems to act well, the mechanical rubbing perhaps doing the most good. Smith * recommends this to be done twice daily, the patient's flannel underclothing not to be changed too often. In more vigorous cases sponging with coldish water, to which spirit or vinegar has been added, is recommended, and on the principle that the sweats act as a means of eliminating morbid matter from the blood, Pollock notes that a few Turkish baths had remarkably ameliorated this symptom in several instances in his experience. Lastly, drugs possessing or supposed to possess an astringent action on the secretion may be tried, as the mineral acids, the oxide of zinc with belladonna in pill, the nitrate of pilocarpine in pill ($\frac{1}{20}$ gr.), or 2 to 4 minims of the Liq. Picrotoxini Aceticus in water.

[In connection with the plan of treating the sweats by feeding the patient at night, it is interesting to remember that absorption from the tissues and absorption from the alimentary canal bear a converse relationship to one another,

* " Consumption, its Early and Remediable Stages," p. 222.

the one being active when the other is in abeyance, and *vice versâ*. During the night, therefore, when under ordinary circumstances absorption from the alimentary canal is at an end, tissue resorption may be relatively more active, so that in phthisis resorption of septic germs is then most likely to occur. Hence a possible explanation of the value of night feeding.]

Hæmoptysis.—This is a very frequent symptom of phthisis, and deserves detailed consideration, not only on account of its great immediate consequence to the patient, but because of its not well understood, but none the less important, connection with the etiology, pathology, and course of the disease.

As regards frequency, it seems to occur in about 70 per cent. of all cases.* It is probably all over as frequent in women as in men, but certainly profuse hæmorrhage is more frequent in the male sex. It is rare in the phthisis of children,† rare also in old persons, and is more frequent in early than in late phthises, and is rare in acute and rapid cases. According to Walshe, it seems improbable that one lung is more likely to act as the seat of hæmoptysis than its fellow, and I am unaware of any observations as to there being any special part of the lung, disease of which is most likely to induce it.

The amount of blood lost varies very much, from a slight streaking of the sputum to moderately severe cases, in which about 40 or 50 grms. (1 or 1½ ounces), or severe, in which from 50 to 150 or 200 grms. (2 to 6 ounces) is lost at one time. In these severe cases, when the hæmorrhage continues for days, 300 to 600 grms. (as much as 20 ounces) may be lost (Lebert).

When the hæmorrhage is copious the blood is fluid, frothy, and bright red in colour at first (unless a branch of the

* Louis states it to be in the proportion of two-thirds ; Pollock, 63 per cent. ; Walshe, 81 per cent. ; Lebert, about 50 per cent.

† Lebert, however, notes a case of fatal hæmoptysis in a child of two years.

pulmonary artery has been opened into); when it is ceasing, the blood expectorated which has lain some time in the tubes is darker in colour and sometimes clotted.

As regards the precise mode of causation, there is some difference of opinion; a division, however, of phthisical bleedings into erosive and congestive is convenient from a clinical point of view. By the erosive is meant the hæmorrhage caused by rupture of a blood vessel of the lung, the result in early phthisis of tubercular infiltration of its walls, and in later cases of the separation by ulceration of softened tubercular or catarrhal-pneumonic foci (cavity formation), or of the giving way of the miliary aneurisms of cavities. By the congestive form is meant an oozing of blood through the walls of the capillaries round an inflamed focus in the lung, or from the vessels of an intensely hyperæmic bronchial mucous membrane.

In the view that erosion in one or other of the ways mentioned is a frequent cause of bleeding, all are agreed; but whilst some, as Pollock and Niemeyer, have attributed to congestion or hyperæmia of lung tissue or bronchial wall an important *role* in its production, especially in the early stage, others, as Laennec and Rindfleisch, have denied this, and have described erosion as the main factor in all phthisical hæmorrhages.

This leads to the important question whether or not bleeding from the respiratory tract can originate a phthisis (phthisis ab hæmoptöe). As an old and well worn subject, however, it need not be discussed in minute detail.

That hæmorrhage can occur from pulmonary tissue or bronchial mucous membrane independently of tubercular disease, needs no argumentation. It is seen frequently in severe bronchitic and cardiac cases, in the hæmorrhagic diathesis, and in purpura; and the common occurrence of bleeding from the nasal mucous membrane might lead us to expect similar phenomena in the bronchial. Further, hæmop-

tysis in women, apparently vicarious to menstruation, along with the observation that a sudden check to the menstrual flow in phthisical women is frequently followed by severe hæmoptysis,* would seem to indicate its occurrence as the result of other causes than erosive lesions.

The possibility, however, of blood effused in either of these ways leading to the onset of pulmonary phthisis is a much more difficult matter. In favour of and against it are the following arguments :— †

I. (In favour.) That profuse and repeated hæmorrhages occur in individuals who present no physical signs of tubercular or other disease, who enjoy good health, and who never become phthisical. Referring to such cases, Pollock lays down as a law, "that the diagnosis of tubercle cannot be made from hæmoptysis alone, no matter what its character may be."

(Against.) That though repeated and profuse hæmorrhages occur in individuals who at the time present no physical signs of disease, and who remain free from consumption, this is no argument against tubercular erosion as their cause. The absence of physical signs during the period of the hæmorrhage is to be explained by the minuteness of the lesion, an explanation which is further strengthened by the consideration, that the thorough exploration of the chest necessary to determine positively the existence of disease cannot in the interests of the patient be carried out. The absence of all physical signs of mischief, when, after the effects of the hæmorrhage have passed off, the chest can be carefully examined, may also be explained by the disappearance of the lesion, and this explanation is again strengthened by the consideration that the bleeding may have had a salutary effect on the lung disease. Further, though recoveries

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* Both of these statements have been denied. Compare Lebert, *ibid.*, vol. ii., p. 190.

† For a good *resumé* of this subject see Pepper's System of Medicine.

from such hæmorrhages may occur, prolonged observations of patients who have been so affected show in them a special liability to consumption.

II. (In favour.)   That a hæmoptysis in a phthisical case frequently leads to an increased rapidity in the downward course of the disease, revealed by increase of fever and extension of lung mischief, in such a way as to indicate that effused blood carried to parts of lung comparatively healthy may there set up inflammatory and destructive changes.

(Against.)   That hæmoptysis in phthisical patients has as frequently no fever nor increased rapidity in the diseased processes following it, and that when such morbid alterations present themselves they are to be regarded, not as the effects of the hæmorrhage, but as the result of an acceleration in the course of the disease induced by some general cause.   Also that, as the copious bleedings in cardiac cases never lead to phthisis, blood in the air passages does not act as an irritant.

III. (In favour.)   That phthisis follows hæmoptysis so frequently and directly, that they must be looked upon in the relation of cause and effect.

(Against.)   That in the majority of such cases, closer questioning demonstrates that lung mischief has existed antecedent to the bleeding, and that although in some few, no history of previous ailment is obtainable, the existence of slight tubercular infiltration cannot be completely negatived.

Taking all these circumstances into consideration, I am inclined to believe that, although rare in the extreme, phthisis ab hæmoptöe may have a real existence.   That the bleeding in cardiac lesions does not lead to phthisis may be explained, by supposing that the lung tissue is then in a condition in some way antagonistic to that process, and is no more to be looked upon as an argument against the theory, than is the observation, that some individuals can breathe for long an atmosphere containing dust particles or tubercle bacilli, an argument against these latter being fruitful causes of lung destruction.

Take for example the following cases. A man, aged 35, with an excellent family and personal history, falls through the planking of a scaffolding, and is caught by his chest between the arms. He is able to recover himself, and then feels only a little shaken and sore, his right side especially. In a few minutes he coughs up a large quantity of blood, and hæmoptysis, in spite of rest and treatment, lasts for three weeks, being followed by a muco-purulent sputum, and phthisis of the right upper lobe. Again, a butcher lad of 18, with an equally satisfactory family and personal history, after a kick from an ox in the lower axillary region of the left chest, has hæmoptysis, and eventually slowly progressive phthisis of the left lower lobe supervenes. A healthy sailor, aged 23, when aloft, slips, and saves himself by seizing hold of the rigging with his right hand, obtaining his footing upon it after a very severe strain. Immediately afterwards he has hæmoptysis, and subsequently phthisis, most markedly of the right upper lobe. Of course it may be said that in such cases the tubercular lesion had pre-existed, or that the injury which caused the bleeding, and not the bleeding itself, had caused the disease, but such arguments would tell equally against any acknowledged morbific agent. Bleeding cannot occur without some, it may be only capillary, vessels giving way, and blood cannot exist out of its place, and in the air passages, without altering in some way the nutrition of the part. Such tissue and trophic disturbance may therefore constitute the conditions essential to the implantation and growth of the bacillus, hence, an individual may, as the result of muscular strain, crush, &c., suffer from a hæmoptysis, and become phthisical, who otherwise might have escaped the disease.

Remembering then that hæmoptysis may possibly occur without phthisis, and that it may directly or indirectly lead to the disease, let us now discuss the subject of hæmoptysis in phthisis in detail.

1. In the great majority of cases of consumption, the onset of which is ascribed by the patient to a blood spitting, the bleeding is due to tubercular disease of the vascular walls. On closer questioning, it will be found that though the cough may hardly have been noticed, the patient has had chest pain or dyspepsia, or has been somewhat out of health for some weeks previously, that he has indeed presented the initial slight symptoms of the tubercular form of phthisis. In these circumstances, the blood expectorated is arterial in character, and as the result of the affected vessel being small, and the ulcerated wall soon becoming occluded by clot, seldom profuse.

2. The bleeding which occurs in the course of developed phthisis, either of the tubercular or pneumonic form, which comes on suddenly, and in which the blood is arterial in character, is probably also due to an opening into a blood vessel, the result of tubercular erosion, or of tubercular or inflammatory softening and ulceration. Though more profuse than the former, it may not be excessive.

3. The bleeding which occurs in old standing cases, in which there is extensive fibrosis with cavity formation, is probably due to the rupture of one of the small aneurisms of a cavity wall. It is also apt to be sudden in its onset; the blood is arterial in character (unless the rupture be into a branch of the pulmonary artery), and the amount usually excessive.

4. The bleeding which comes on gradually in the course of a phthisis in which the pneumonic process is present, which accompanies the ordinary cough, which is frequently most marked on waking in the morning, and which continues for days or weeks together, is probably due to oozing of blood through the capillary walls, as the result of congestion. In such circumstances the blood is more or less mixed with muco-purulent expectoration, is dark in colour, and in quantity comparatively small. The patient's pulse in such cases is usually soft and compressible.

5. Lastly, there is that form of bleeding which, according to Niemeyer, and those who, like him, have accepted the phthisis ab hæmoptöe theory, may occur without the existence of phthisical disease in the lungs. In all such cases there is of course the possibility that, although not revealed by physical signs, pre-existing tubercle has caused the bleeding as in the first form. The cause of the bleeding is, however, according to Niemeyer, a weakness of the vascular walls in the bronchial mucous membrane. The hæmorrhage is sudden in its onset, is often profuse, the blood is light in colour, and there is frequently a history of exertion or strain.

But, just as in the lung the phthisical processes are never simple, just as tubercular deposit, catarrhal inflammation, fibrosis, and cavity formation are going on together, so the various forms of hæmorrhage may to a greater or less extent be co-existent. Omitting the last form as somewhat theoretical, we must remember that in an early phthisis cavity formation may cause aneurisms to form and rupture, and that in a later stage tubercular ulceration into vessels may occur, and that congestive oozing may take place at any period. As still further complicating the question, it is to be borne in mind that this congestive form may be stimulated by the erosive. Thus, the opening may be into a very small vessel, or after hæmorrhage from erosion of any kind, a certain amount of the blood may continue to ooze out, and being dark in colour, and being gradually got rid of in the sputum, it may be practically indistinguishable from a congestive hæmorrhage. Just then, as in the phthisical disease, a recognition of the prevailing type, tubercular, inflammatory, or fibroid, is all that can be attempted, so with the bleeding, we need only seek to determine the prevailing form.

The effects of hæmoptysis, as of the other phenomena of phthisis, have to be considered theoretically and practically, in part as salutary, and in part as injurious. Taking the latter

first, as being the aspect of the case with which we are most familiar, there is in the first place the shock to the system. This, especially in first attacks, is apt to be very great, and although it can apparently be readily recovered from in cases which run a favourable course, it cannot fail, by affecting the general nutrition, to exercise an injurious effect on the pulmonary disease. Next, there is always the risk of broncho-pneumonic mischief being set up at other parts of the lung by the blood. This is betokened by constitutional disturbances, chest pain, heightened temperature, and quickened pulse occurring two or three days after the hæmoptysis, and if severe, it may mark the beginning of a rapidly fatal acute pneumonic phthisis. It is necessary, however, to mention, that in many instances, especially of the fibroid type of phthisis, in which profuse hæmorrhages from time to time occur, evidence of subsequent broncho-pneumonic change is conspicuously absent. The pulse remains slow, quiet, and of good strength, the temperature is absolutely normal, and the cough seems no more frequent than is really required to remove the blood which is slowly oozing from the gradually closing vessels, or which has been inhaled by other parts of the lung during the hæmorrhage.

Further, there are the injurious effects from simple loss of blood. A directly fatal result may follow from syncope, from asphyxia, or from a combination of the two, and it is necessary to remember that, in such cases, comparatively little blood may be expectorated, the bleeding then being mainly into the air passages and lung cavities. The debilitating effects of severe or continued hæmorrhage on the general nutrition in less urgent cases need only be mentioned, and the liability of such cases to fatal syncope, from the trivial exertions from which even existence in bed cannot altogether protect them, requires to be borne in mind.

Turning now to what may be regarded as the salutary aspect of hæmoptysis, less can be said, and what information we have is certainly of a less positive character. Still it is

important. Thus, after a moderate hæmoptysis in the course
of a phthisis, the patient will often express himself as feeling
relieved to some extent, his cough will be easier, and he will
feel generally better. Such a result may be regarded as being
due to relief of the inflammatory congestion, which surrounding
tubercular or catarrhal-pneumonic products may be conceived
to be in excess of its real requirements. On this matter,
Jaccoud has expressed himself very decidedly. He says,
"During the initial period, when the danger is specially due
to attacks of congestion, which cause the lesions to increase
in size, the hæmoptysis may be as it were critical in character,
and dissipate for a time at least threatening inflammation.
In such cases the event, far from being a sign of incurability,
is on the contrary a healthful process." Lebert too gives a
very similar opinion. Further, in connection with the hæmorr-
hage itself, we must remember that the state of nervous
shock which occurs, may be regarded as being so far favour-
able, for by the quietened respiration, slowed and weakened
heart, and lowered blood pressure, clotting and consequent
obliteration of the eroded vessel is promoted.

In the *prognosis* of hæmoptysis, it is necessary to remember
that in early phthisis, even though it be profuse, it is almost
certain not to be immediately fatal, and that in later cases,
due as it usually is then to aneurismal rupture, it is extremely
seldom followed by a fatal issue. Thus, out of 131 cases
given by Walsh, in only 2 could the fatal result be directly
ascribed to the hæmorrhage : in one, death occurred at once
by suffocation ; in the other, copious hæmorrhage continued,
and proved fatal after five days. In a very large proportion of
fatal cases, death occurs before treatment of any kind can be
employed, hence the mere fact of a patient with hæmoptysis
coming under treatment, is so far favourable. The immediate
prognosis therefore is eminently hopeful, and if the patient's
general condition is fair, and if his pulse continue quiet, this is
specially so, even though the hæmorrhage be tolerably profuse.

The ultimate prognosis is, however, another matter, and should not be discussed unless the patient's history and physical condition is known, or until it can be ascertained. It should always be guarded, and in forming it, besides the patient's personal and family history and mode of livelihood, the following considerations may be useful.

Hæmorrhage may be viewed more favourably if it has come on from a distinct cause, as exertion or muscular strain, than when there has been little or no exciting cause, or as Niemeyer puts it, " The slighter the provocation, so much the graver is the omen." That this should be the case, can easily be understood, for it implies that the rupture is due to increased vascular tension rather than extensive disease, and that the patient's general nutrition is not much impaired.

The prognosis is better if the hæmorrhage is the first symptom, and if there is little or no lung mischief recognisable upon physical examination, it is worse if it has supervened on a cough, loss of weight, or other phthisical manifestation, and if physical examination shews pronounced disease.

The continuation of the hæmorrhage for some days, even though it be not exhaustingly profuse, is unfavourable, as it is apt to mark broncho-pneumonic changes, and rapid lung disintegration. In such cases, the patient's general condition, high temperature, sweating and soft rapid pulse, are important, as aiding us to form an unfavourable prognosis.

Lastly, in cases of old standing phthisis of the fibroid type, we must remember that, although profuse bleedings may be recovered from, the patient's nutritive capital is always being trenched upon; and that with every recurrence, a great liability to which exists, the chances of recuperation are less and less. In such cases, the state of the pulse is probably the best guide. So long as this remains quiet, and of fair strength, prolongation of the disease may be anticipated.

Since in the great majority of cases hæmoptysis does not

directly tend to a fatal issue, its treatment is in the main expectant. When coming on suddenly, and when profuse in quantity, rest in bed is absolutely essential, the patient's head should be kept low, and he should be cautioned against the slightest movement, speaking should be prohibited, and he should be advised to cough only when absolutely necessary. Small pieces of ice to suck may be given him, and a slight tendency to syncope being salutary, stimulant restoratives are to be avoided. As regards drugs, the routine practice is to administer ergotine hypodermically, or to give sulphuric or gallic acid, or one or two teaspoonfuls of finely powdered dry salt, but it is to be remembered that derivatives are usually of much more use than astringents. The state of the bowels should therefore be inquired into, and if confined, a purge, by relieving the portal circulation, will often be markedly beneficial. In most cases satisfactory progress will be met with, but should profuse bleeding continue, what we have further to do is mainly to follow out more thoroughly the treatment already indicated. For example, the cough, if it seemed to be tending to prevent coagulation in the vessels, may be quieted by opium, and more complete rest of the lung may be obtained by strapping the side of the chest in which it is believed the rupture has occurred. Again, the ice bag often seems to do good, and derivation may be practised by dry cupping, skin counter irritants, or hot foot-baths. Junod's boot has also been recommended. In addition, there are hosts of astringents, acetate of lead, sulphate of copper, turpentine (ʒss. doses in mucilage), Ruspini's styptic, Warren's styptic, &c.

Where the hæmorrhage is not profuse, its treatment will depend on the conditions which may be supposed to be producing it. In the case of the oozing which occurs from tubercular erosion of small vessels, or which follows a profuse bleeding, little need be done directly. If the cough is severe, and seems to be interfering with the coagulation processes, rest

and sedative cough mixtures are indicated, always however
remembering that retained blood may be injurious, and that
a certain amount of cough is useful in preventing this·
Judicious attention to the bowels is always required, and
if astringents seem necessary, a little Ruspini's or Warren's
styptic or tincture of hamamelis may be found useful. In
cases where we may suppose the hæmorrhage to be mainly
of the congestive form, digitalis, in the form of Niemeyer's
pill at night, or the tincture given in 5 or 10 minim doses
during the day, is what I have found most useful. A word
of caution is here required, for there is no doubt that where
fibrosis, cavities, and exposed vessels exist, this drug may, by
increasing the blood pressure, induce a bleeding. In old
standing cases of phthisis, it must therefore be given very
carefully ; in early cases, its use is less hazardous ; in all, how-
ever, a soft weak pulse is the main indication for its employ-
ment. A similar caution applies to the use of iron and
arsenic, and of counter irritation by blistering, in cases where
profuse bleeding has occurred, or might be anticipated, these,
like digitalis, being remedial measures, the value of which
in appropriate cases is undoubted.

CHAPTER VII.

SYMPTOMS AND COMPLICATIONS OF PHTHISIS, AND THEIR TREATMENT.

"So careful of the type she seems, so careless of the single life," which is true of Nature's behaviour towards life as a whole, is no less true of her mode of dealing with humanity in the struggle between individual life and disease. Here it has evidently been ordained that all efforts must be made to crush out disease, and no matter how much pain or distress these efforts cause, or how by their excess or by their secondary, tertiary, or still more remote effects, greater pain or greater distress is entailed, this struggle must be maintained. The individual life is as nothing in the process, and its sacrifice occurs so frequently, and often so much apparently as the direct result of the struggle, that the main cause of it all may readily be overlooked. Thus in phthisis the cough and expectoration, the high temperature, anorexia, sweating, and emaciation are all so obvious, and their effects on the organism so distressing, that we are too apt to look upon them as the direct causes of the patient's sufferings. In our consideration of these symptoms we have endeavoured to avoid this mistake, and we have noted that in all of them salutary aspects may be more or less clearly discerned. This is absolutely essential if our treatment is to be really useful, for although in phthisis, as in most other maladies, it is too much the case that the physician's ignorance or impotence limits his attempts for good to the amelioration of distressing symptoms, and debars him from the employment of methods

which will act on the disease itself, it is to be remembered that Nature, steadfastly, sternly, and even callously, is always acting in the direct way. Underlying her symptoms and the suffering which they cause, we must always look for Nature's meaning ; and the better and clearer we can interpret this, the better and clearer shall we see how to act.

In the symptoms of phthisis which we have been discussing in detail, we have always tried to discover their meaning; what in them is acting beneficially has been recognised, and what in them it seems necessary for the patient's welfare should be repressed or modified, has been discussed. There are yet many phenomena and events closely associated with the disease which deserve consideration. Of some of them the bare meaning is all which it is important to ascertain, treatment being, if at all, but seldom required ; of others the bare meaning is obvious enough, and the treatment is the more important matter. Examples of the former are dyspnœa, pain, club fingers ; of the latter, disorders of the digestive tract, liver, kidney, pleural and laryngeal complications, &c.

Dyspnœa.—This, as a symptom of phthisis, is certainly what might be expected ; but there is no doubt that many cases run their course without it being complained of to a great extent. This is, however, only the case if active exercise be avoided ; upon exertion it becomes obvious enough. Practically it is found to occur for the most part in the early stages of phthisis, when the patient is moving about ; in chronic fibroid cases where, with extensive lung disease, there is a considerable amount of bodily vigour ; and towards the close of the disease in all its forms. Further, in all cases of phthisis, although dyspnœa may not be complained of, careful observation, *i.e.*, counting the respirations, is sure to show at one time or other increased respiratory activity.

The causes of dyspnœa are various. One very important one is stated to be the diminution in the extent of breathing surface brought about by the pulmonary disease. This, how-

ever, in itself is probably not a very potent cause, a statement which will be acknowledged when it is remembered that the normal extent of respiratory surface is immensely in excess of what is ordinarily used. The vital capacity in a man of middle height being 230 cubic inches, and the breathing volume only about 20 or 30 cubic inches, a large encroachment may occur without being felt by the patient so long as he is resting quietly, and Hutchinson states that in phthisis a diminution in the vital capacity of 90 per cent. may exist and yet life be maintained.

Fever, or rather the increased tissue metabolism which it implies, is a very important cause of quickened breathing. This is evidenced by the close correspondence between the number of respirations on the one hand and the temperature and pulse rate on the other, which phthisical charts usually show, and as alluded to by Ruehle,* this is why in such cases the respirations are so frequently more rapid in the evening than in the morning. It is to be remembered, however, that though during the course of the disease this relationship may be observed, in the later stages it is apt to be disturbed. The cough becoming more severe, expectoration more difficult, and the supervention of bronchitis and pulmonary congestion, all tend to quicken the respirations out of proportion to the heart beats, whilst in the state of semi-collapse previous to the fatal issue, distinct lowering of the temperature, with continued rapid breathing, may be noticed.

A third possible element in the production of dyspnœa which requires mention is, the irritation of the peripheral extremities of the vagi nerves by miliary tubercles. In the more rapid forms of phthisis in which this tubercular deposition takes place, fever and bronchial catarrh are concomitants, and to them may be ascribed the larger share in the production of dyspnœa ; but cases occur again and again where these latter alone do not seem sufficient to account for the increased

* Ziemssen's Cyclopædia, vol. v., p. 531.

respiratory activity, hence peripheral nerve irritation has been looked to for an explanation.

Lastly, if bronchitis, pleurisy, or pneumothorax, &c., occur, the dyspnœa may, of course, become excessive. This, however, will be discussed by and bye.

The dyspnœa of phthisis seldom calls for separate treatment ; in any stages, digitalis to strengthen the heart may be used, due regard being paid to its risks as regards bleedings in chronic cases, with cavities and exposed aneurismal vessels. Opium to allay the irritability of the respiratory nerve mechanism is indicated in the later stages, where, with irritating cough, it is preventing sleep, and at this time large poultices to the chest will, by relieving pulmonary congestion, often be found of service.

Pain is a common symptom of phthisis, but except in complications, as acute pleurisy or pneumothorax, it is never very severe. It occurs frequently in the prephthisical stage and in the early stage of the developed disease, and affecting usually the chest, shoulders, and back, and frequently changing its position, it is commonly ascribed to neuralgia or rheumatism. In the course of the disease it is also common, the forms of phthisis in which it is most so being the pneumonic and fibroid. Then it can more certainly be ascribed to slight but continued pleuritic attacks, and indeed when we think of the large extent of adhesion between lung and pleura which *post mortem* examinations in phthisis usually reveal, we are apt to be surprised at its slight prominence as a symptom. What may, however, be in part an explanation of this is, that the pleuritic inflammation has extended from above downwards, and that consequently there can have been between the pulmonary and costal pleura but little of that rubbing movement of inflamed surfaces to which the pain of pleurisy is so much due.

In addition to pleuritic pains, it would seem that, in long standing cases of pneumonic and fibroid phthisis, the fibrous tissue formed in connection with the deep layer of the pleura

and interstitial tissue of the lung is, like similar tissues formed at the seat of old injuries, sprains, &c., apt to become painful with changes of atmospheric conditions, as temperature and humidity. It is further worthy of note that affections of the lung tissue, apart from the pleura and this fibrous tissue, as for example pneumonic processes, ulcerated cavity walls, or even ulceration of the bronchial mucous membrane, do not cause pain.

Pain in phthisis seldom requires special treatment, slight counter-irritation, restraint of chest movement by bandages or strapping, and the use, especially in the fibroid cases, of iodide of potassium, being for the most part all that is required.

Clubbing of the fingers has been described as a more or less distinctive symptom of phthisis by almost all observers, from Hippocrates downwards. It has been carefully described and figured by Pollock, and is considered by that author of some prognostic importance, inasmuch as it is associated specially with the chronic and long-enduring forms of the disease. The proportionate number of all cases of phthisis in which Pollock found it to exist was about 27 per cent., as against about 73 per cent. not clubbed ; it seemed very slightly more common in the male sex, and the exceptional cases where clubbing occurred without phthisis he notes to have been pleurisies, empyæmas, and cardiac disease. He further observed its special frequency in phthisis when complicated with cardiac valvular disease. By other observers its special association with consumption has been denied, and the balance of opinion tends probably to the view that the clubbing is to be connected with impeded venous circulation in general rather than with any special malady. The appearance of the fingers seems to bear this out, for lividity is common.

For the production of clubbing, processes both of hyper-trophy and atrophy seem to be necessary, and the thickening of the finger points becomes intensified as emaciation proceeds by the thinning of the digit higher up. With the bulbousness a

curving of the nail in its long diameter, giving it a claw-like appearance, and a tendency in it to transverse cracking is also noticeable. That other epidermal appendage, the hair, presents frequently also certain symptomatic changes. In individuals of a phthisical tendency a profusion of it is often remarked, but in the advanced stages, and when fever is present, falling out and thinning is frequent.

Other appearances more or less symptomatic of phthisis are to be looked for in the mouth. Foremost among these is a red streak at the edge of the gum opposite the incisor teeth, and usually on the lower jaw. It was first described by Fredericq in 1847, and is described and figured by Thompson,* but as it probably is as frequent in other debilitating affections as it is in phthisis, it is considered of little diagnostic importance.

Secondly, the appearance of the soft palate and uvula is often characteristic in phthisis. These parts are often anæmic, pale and dry looking, and show coursing over them a number of bright red blood vessels.

Thirdly, *Aphthæ* are not uncommon towards the close of life in phthisis, specially in the tubercular forms, and where laryngeal phthisis is also present. They are, however, not limited to phthisis, being found in patients dying of other diseases, as cancer. They occur as whitish spots or patches, like particles of curdled milk, on the mucous surface of the cheeks between the jaws, and they may extend to the lips, tongue, palate, and pharynx. Scraped off, they are found to have lain on a congested or even inflamed surface, and examined microscopically, they exhibit epithelial cells, and the spores and filament of the oidium albicans. The complaints which they cause are usually of dryness or a burning feeling in the mouth, but when severe and extensive, difficulty in mastication and deglutition may occur.

Little is required for them in the way of treatment, except

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* Clinical Lectures on Pulmonary Consumption, London, 1854.

frequent cleansing of the mouth with water, or with a mixture of wine and water, or the application of the glycerinum boracis.

Tubercular ulceration of the tongue, though a rare complication of phthisis, has been carefully studied and described (Trans. Path. Soc., London, 1884, Butlin on the Tongue). It is commoner in males, more in adults than in children, and occurs most frequently in the latter stages of the disease.

Its most usual position is near the tip of the tongue. Beginning as a small pimple, this bursting, forms an ulcer, which, gradually increasing in width and depth, presents the following characteristics :—The surface is rough or granulated, and may be covered by a greyish secretion, or may have the appearance of raw meat. The edges, irregular in shape, are not swollen nor indurated, but are distinctly undermined. In its greatest diameter it may be ½ or ¾ to 1 inch or even larger. Sections of it under the microscope show in its floor and edges the usual appearance of tubercle, viz., an infiltration of the tissues with small tubercle cells, and here and there tubercular nodules with giant cells. Tubercle bacilli have been found in the sections, and are to be looked for in scrapings from the surface of the ulcer.

The main symptom caused by its presence is pain, which, owing to the richness of the tongue tip in sensory nerves is often very severe, and is increased on taking food. When the pain is severe, salivation is present. The submaxillary gland may also become enlarged.

The exciting cause of the complication seems usually to be some breach of surface of the mucous membrane of the tongue, and when it is remembered that in the act of expectorating there is great risk of abrasion of the front part of that organ by the front teeth, specially if these are sharp and pointed as the result of caries, we can understand how easily this may occur, and how then even direct inoculation from the sputum may be effected.

For the treatment of these ulcers excision and cauterisation have both been recommended, but occurring, as they usually do, in advanced phthisis, palliative treatment is in the majority of cases more appropriate. If decayed teeth are present, they should be removed, or they may be covered with a gutta-percha shield; food and drink should not be taken hot, and hard food should be avoided. Lotions of borax or chlorate of potash may be applied, and Butlin has recommended cleaning the surface of the ulcer with a soft brush and a little piece of absorbent cotton wool, and dusting it over with the following powder :—

> Iodoform, gr. i.
> Morphia, gr. ⅙ to ½.
> Borax, grs. iii.

Cocaine may be applied if the pain is severe, and for extreme cases division of the lingual nerve has been recommended.

Tubercular deposit and ulceration may also occur in the course of a phthisis on the soft palate, posterior wall of pharynx, tonsil, naso-pharynx, and nasal cavity (usually on the septum). They are treated as in the case of the tongue, by the local application of antiseptics, and sedatives if pain.

In pulmonary consumption, the digestive system always shows that to a greater or less extent it is sharing in the general disturbance of nutrition, and the symptoms which in this way most frequently occur are vomiting, with nausea, anorexia or gastric pain, and diarrhœa, with or without intestinal pain. These, therefore, have now to be considered, and with these the fistula in ano, and the morbid changes which are apt to take place in the liver, kidney, and spleen, require full discussion.

Beginning with the stomach, we can easily understand how symptoms of disorder should be so frequent. In the first place, it is to be remembered that, as the result of the debility of the phthisical state, atonic dyspepsia, with anorexia and frequently vomiting after food, is often met with, and occurring,

as this often does, at the beginning of a phthisis, it is very apt
to mask the onset of the grave disease. Although in such
circumstances cough is not complained of, the anæmia, loss of
weight, and the somewhat rapid and variable pulse, should
always excite suspicion.

Secondly, in phthisis, when any fever is present, we must
always expect evidence of gastric catarrh, dyspepsia, nausea,
&c., for the general disturbance which fever entails always
interferes with the digestive power, by altering the quantity
and quality of the gastric and other secretions.

Thirdly, vomiting and gastric pain may readily be excited
by severe coughing. The pain is probably due to strain of
the diaphragm and abdominal muscles, and the vomiting can
be accounted for by the close relation of the gastric and
respiratory centres in the medulla, both these centres being
in an excitable condition, as the result of the pulmonary lesion
and of the gastric catarrh.

From what has just been stated, it may be gathered that
the pathological changes in the stomach are usually those of
simple catarrh. Tubercle of that organ is extremely rare, and
when it does exist, it is the result of intestinal tubercle, which,
present to an extreme degree, has spread upwards.* It is,
even then, however, absolutely and comparatively so limited
in extent, that it does not produce recognisable symptoms.

The cases of phthisis in which gastric symptoms are
specially common, are the acute and rapid ones, hence in
those instances in which gastric troubles show themselves
early, a most unfavourable prognosis can be given. In
chronic cases, on the other hand, there is comparative im-
munity from dyspeptic symptoms. At the termination of all
cases, however, they are apt to become more prominent, hence
when a chronic case begins to show continued evidence of
such disturbance, the final break-up is to be feared.

Evidence of involvement of the intestinal tract in phthisis

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* Lebert, "Klinik der Brustkrankheiten," Bd. ii., p. 136.

is of extremely frequent occurrence. Louis,[*] for example, states that diarrhœa is almost as common as fever, and notes, that of 112 phthisical patients, five only were exempt from it. This seems rather a high estimate, but when we remember that it includes diarrhœas of all degrees of severity and duration occurring in individuals whose illness may last for years, that disturbance of intestinal as of gastric digestion is always associated with fever, and that in phthisis tubercular and waxy disease of the intestine is apt to come on, this frequency seems hardly more than what might be expected.

In connection with this symptom, *tubercular ulceration of the bowel* is the subject which first requires attention. Its frequency in phthisis is about 50 per cent. in adults, and it seems equally frequent in males and females, although, as stated, p. 16, intestinal tubercle occurring independently of phthisis, seems after the tenth year to be rather more frequent in females. In children and youths it is undoubtedly more common. This is what might be expected from the fact already alluded to, that in early years tubercle is more prone to attack the intestine than the lung. I regret I have no statistics of my own to offer as to the relative frequency of this complication in children's phthisis, but Widerhofer states, that of his cases, in 101 instances of tubercular ulceration of the bowel, pulmonary phthisis was in 76 the principal lesion.

Tubercular ulceration affects mainly the same structures as are involved in typhoid fever, namely, the solitary and Peyer's glands. It is therefore most marked about the lower end of the small intestine, and specially so just above the ileocœcal valve. Of the large intestine the cœcum is the part most frequently affected, but the lesion may be found in patches all along the tube.

[The distribution of these ulcerations is of interest in connection with the view that they are brought about by infection from swallowed sputum. Without in any way

* Louis, " Researches in Phthisis " (Sydenham Society, 1844), p. 222.

gainsaying the possibility of such a process, the apparent spreading of these in the case of the small intestine from below upwards, and in the large from above downwards, is an argument against it, and tends to show that the tubercular process follows the distribution of the blood glands, that is to say, that with tubercle, in whatever way implanted, the soil is more important than the germ.]

The process begins in the solitary and Peyer's glands by cell proliferation. In the solitary, this goes on to the extent of producing great swelling and congestion of the parts; softening of the mass then occurs, the overlying mucous membrane gives way, and by the escape of the contents, a small, deep ulcer with overhanging ragged edges is produced. In the agminated or Peyer's glands, this process takes place in several parts at once, so that the patch may present a honey-combed appearance, from the small ulcers being separated by bridges of undestroyed mucous membrane. Tubercular ulcers tend to spread by deposition and breaking down of tubercular cells in their walls, and though they begin in a gland, they are not limited as regards extent by it. Thus, in the small intestine they tend to spread in a transverse direction beyond the limits of a Peyer's patch, and they may even form an ulcerated band round the entire circumference of the bowel. In the large intestine the mucous membrane may be destroyed over large areas. Such ulcers further tend to become deeper, and cause perforation. If the tube of intestine is free, this takes place into the peritoneal cavity, and is followed by a rapidly fatal peritonitis; but if adhesions, the result of the local peritonitis with which the ulcerative process is accompanied, have previously occurred, an abscess forms, or a fistulous opening into a neighbouring hollow viscus is produced. The locality in which perforation is most apt to occur, is, as might be expected, the lower part of the ileum.

Can a tubercular ulcer of the intestine heal? There is no

doubt that, as with tubercule elsewhere, this is possible, by the discharge of the tubercular matter and cicatrisation ; and post-mortem examination not infrequently reveals that such a process has more or less perfectly occurred. But, as with tubercle elsewhere, whilst some lesions are healing, others are spreading, and the contraction which the cicatrisation entails, is apt to lead to further trouble. The chances therefore of permanent improvement are very small.

Of the symptoms of tubercular ulceration of the bowel, diarrhoea is naturally the most prominent, and in severity, it may be said to vary with the amount of the intestinal lesion. To this statement, however, certain qualifications must be made. In the first place, it is to be remembered that post-mortem examination may reveal the existence of ulceration in cases in which not only no diarrhœa has existed, but in which the stools have not differed in colour and consistence from the normal, a point which is looked upon as denoting that to the usually accompanying catarrh, rather than the ulceration itself, is the symptom to be ascribed. Secondly, the diarrhœa will vary in severity according to the locality of the ulceration. The more this is limited to the small intestine, the less is its frequency, and the less are the changes from the normal in its character ; whilst, on the other hand, when the large intestine is involved, the more frequent and fluid are the stools. Further, when in the large intestine the ulceration is low down, the diarrhœa is apt to be dysenteric in character, is accompanied by tenesmus, and the stools are scanty, muco-purulent, and often contain almost pure blood.

Pain and tenderness on pressure are also symptoms of bowel ulceration. In situation, they usually correspond to that of the lesion, and are therefore most marked in the right iliac fossa and hypogastrium. But they may be migratory, and they may be at times absent altogether, points which indicate that the mucous coat is not specially sensitive, and that tympanitic distension, spasm of the muscular walls, and

irritation of the serous coat, are their special causes.   When
perforation occurs, the pain is extreme.

As a complication of phthisis, bowel ulceration is usually
met with in the later periods of the disease.   It is then apt to
be violent, and extremely exhausting to the patient, and
though, as with the other complications of phthisis, an
amelioration in the severity of the pulmonary symptoms may,
as the result of its onset, frequently be recognised, emaciation
makes rapid strides, and the fatal end is approached with
greatly increased rapidity.   In other instances, it may come
on much earlier in the disease, and it may, indeed, for months,
precede the onset of lung symptoms.   In Louis' cases, it
occurred at the outset of the phthisical disease in one-eighth ;
in the majority, it commenced during the later half; in the
rest, not till the closing days of existence.   Its early occur-
rence is specially the case in children's phthisis, in connection
with which subject references have already been made to the
association of the abdominal organs with tubercle in the
early years of life, and to the development of pulmonary
tubercle by auto-infection from the abdominal organs at this
period.   The greater risk in children of infection of tubercle
from swallowed sputum, has also been by most writers
alluded to.

Lastly, diarrhœa may be caused by waxy disease of the
intestine, existing alone, or complicating intestinal ulcer. This,
however, is less common, and since, for the most part, waxy
disease in the intestine occurs along with similar changes in
the kidney, spleen, or liver, its diagnosis is usually easily
arrived at.   (See p. 193.)

The treatment of the gastro-intestinal disorders of phthisis,
is a matter demanding the greatest possible attention and
care.   It should always be borne in mind that ulceration
having once become well marked, proves most intractable, and
that the disordered function of the mucous coat of the intes-
tine so apt to occur in phthisis, by impairing its nutrition,

renders it extremely liable to become the seat of tubercular deposit. In all cases then, by way of precaution, the diet should be carefully attended to, the most digestible and the most nourishing food alone being allowed, and the strengthening effects of the digestive function of open air and exercise taken advantage of to the full. The slightest disturbance of the digestive organs should be watched and treated ; if constipation is present, purgatives should be employed with extreme care. The irritating ones should be avoided altogether, and the aloes and iron pill or the sulphur confection used instead. If, with a furred tongue, the stomach seems to be the seat of irritation, small doses of rhubarb and soda may be found useful. If diarrhœa sets in, its possible cause should be looked for among the ingesta, before its stoppage should be attempted by drugs, and potatoes, most green vegetables, and any food which can be mechanically irritating, as oatmeal and fatty matters, should be excluded. For any diarrhœa which sets in, astringents should not be used at once ; castor oil and laudanum, or a mixture of grey powder, and Dover's powder should precede their exhibition. In all cases, it should be remembered that rest to the alimentary tract is valuable, for though it is necessary to get as much food into the patient as possible, any substances undigested are worse than useless. Lastly, the patient should be warned as to the danger of swallowing any of the sputum. When, in spite of precautions, ulceration may be supposed to have occurred, the diet should consist mainly of farinaceous articles, as steamed biscuit and milk, revalenta, corn flour, ground rice, puddings, arrowroot, sago, and so on. In our use of such, we are guided by the idea that they are readily digested by the saliva and gastric juice, and give little digestive work to the diseased lower bowel, and that, owing to their slimy consistence, they are less apt to irritate the weakened mucous membrane. They should be given in small quantities, and often. The fact that there is an intimate functional relationship between all parts

of the digestive tract, should always be borne in mind. Thus
when, as often happens, the taking of food seems to excite
pain and diarrhœa, the use of such sedatives as hydrocyanic
acid or bismuth before food may prove serviceable, or a
similarly good effect on the entire tract may be secured by a
morphia suppository. When the severe diarrhœa has fairly
shown itself, but little can be done. The various astringents,
bismuth, zinc, kino, krameria, coto, may be tried with opium
to relieve pain and spasm, and in advanced cases the starch
and opium injection.*

Counter irritation to the abdominal wall by poultices,
fomentations, mustard plasters or blisters, may be of service,
and Powell recommends in chronic cases the application of a
layer of wool quilted in flannel to the abdomen, to be kept on
by a bandage.

The forms of liver affection which are apt to supervene in
phthisis are mainly the *fatty* and the *waxy* degenerations.
They are both insidious in onset and slow in course, they
cause no pain, and the structural changes which they induce
interfere neither with the portal circulation nor with the
biliary discharge. Hence they cause no special symptoms,
and their precise recognition can only be made by physical
examination, corroborated in the case of waxy degeneration
by evidence of similar changes in other organs.

Of the two, the *fatty* is the more common. Louis has noted
it as occurring in one-third of his cases, and its frequency has
been referred to by Andral, Budal, Murchison, and Frerichs.
In the *post mortem* examinations of a hundred consecutive
cases of phthisis in the Edinburgh Royal Infirmary, I find
that the livers were stated to have been more or less distinctly
fatty in fifty-five. Age seems to have little modifying effect
on it, excepting that, as Lebert † states, it seems less frequent
in children. It seems equally liable to occur in acute and

* 20 or 30 minims of Tinct. Opii in 2 or 3 ounces of starch mucilage.
† " Klinik der Brustkrankheiten," Bd. ii., p. 147.

chronic cases. Sex has a great influence. Louis states that in phthisical women it is more common in the proportion of four to one, and the greater liability of females is noted by Frerichs and Murchison.*

The results to the organism of fatty liver are, as already stated, not marked in character, and it is only when the affection is advanced that, from symptoms and physical signs, its existence can be confidently diagnosed. The derangements caused by interference with the portal circulation, and with the biliary functions, are never sufficient to cause ascites or jaundice, but show themselves as disorders of the gastro-intestinal digestion, distention and tenderness in the epigastrium, hæmorrhoids, constipation alternating with diarrhœa, and a tendency to clay-coloured stools, all of which symptoms might easily be ascribed to other causes. The physical signs are, enlargement of the liver, especially in its longitudinal diameter, without the increased consistence and sharp border of a waxy liver, and without the splenic enlargement and other symptoms of waxy disease.

For the occurrence of fatty liver in pulmonary phthisis there is no very cogent explanation. A view held by many observers is, that owing to the lessened respiratory function which disease of the lung parenchyma entails, there is deficient oxidation of carbon and consequent accumulation. This is, however, unsatisfactory, because, in the first place, in diseases like emphysema, in which the oxidising function is more impaired, there is less tendency to fatty change; and in the second, because with phthisis, fever, which means increased metabolism, is always more or less associated. On a subject about which so little is known, any long discussion would be out of place, but remembering that fatty liver may be caused either by over supply, as in the case of over feeding, or by deficient expenditure, as in the case of the closely confined Strassburg geese, it seems more likely that to this latter its

* See Reynold's " System of Medicine," vol. iii., p. 364.

occurrence in phthisis is in great part to be ascribed. Not, however, because oxidation is deficient, for, as stated above, this is not the case in phthisis, but *because the various tissues of a phthisical individual seem to be unable properly to assimilate the material brought to them by the blood.* This of course traces back the disease to a defective assimilative power on the part of the tissues themselves, and although this is a condition which usually exists with corresponding impairment of the digestive, absorptive, and elaborative functions, there is no doubt that it may exist to some extent independently.   Thus Frerichs, referring to the association of fatty liver with pulmonary tubercle and with drunkards' dyscrasia, says :—" Both of these morbid conditions, however different they may be in other respects, agree in this, that the blood is usually characterised by the presence of a large quantity of fat, and that a milky turbid serum separates from it," a statement which, taken along with the Strassburg geese observations, seems to indicate that the block in metabolism which produces the fatty liver occurs at the tissue assimilation stage. Regarding fatty liver in this way as the result of a failure in the tissue assimilative power, whilst those of digestion, absorption, and sanguification are going on fairly well, we have explained to us how readily the taking of fatty food, as cod liver oil, may in the phthisical accelerate the process.   It seems to indicate also a possible difference between phthisis and a disease frequently associated with it, namely, diabetes. In diabetes, as Frerichs has pointed out, the liver is markedly deficient in fat, hence, although, in it as in phthisis, the anabolic and katabolic processes present abnormalities, the stages in the metabolism at which the disturbances occur are probably different.   In the diabetic, however, as in the phthisical, the weight of the liver does not appear to diminish in proportion to that of the tissues.   In eleven male cases of diabetes in the Edinburgh Royal Infirmary Reports, the average weight of the organ was 3 lbs. 13 oz.

Waxy degeneration of the liver is to be regarded not so much as a complication in itself, as an item in a complication of a far more general character, which involves other organs, and which is capable of exerting an important influence on the course of the primary disease. It is therefore to be considered etiologically, pathologically, and symptomatically as occurring with waxy disease of the spleen, intestine, and kidney. In the liver in phthisis, the waxy is much less frequent than the fatty change. This has been pointed out by Meckel, Willis, Frerichs, and others ; and Murchison states, that of 52 persons dying from tubercle, the liver was fatty in 20, and waxy in 6, and that in three of the 6, there was also caries of bone. But if we consider waxy disease as affecting the other organs as well, the proportion rises. Thus, Powell found waxy disease in 20 per cent. of his phthisical *post mortem* examinations at the Brompton Hospital, and in 100 consecutive cases in the Royal Infirmary of Edinburgh, I have found it present in 30. Like phthisis itself, waxy disease occurs mostly in adolescents and young subjects. As regards sex, of Powell's 20 cases, 8 were males, and 12 females, and a great preponderance of female cases is shewn by the results I obtained in Edinburgh. Thus, of the 100 cases of phthisis, 71 were males, of which 16, or 22 per cent., had waxy disease, and 29 were females, of which 14, or 48 per cent., were found thus affected. Further, the most advanced examples of the degeneration, in which liver, spleen, kidney, and intestine were all together involved, occurred in women. This shows a much greater liability to it in the female sex, a result which is peculiar when taken into consideration with Frerichs' liver cases, which shewed, out of 68 instances, 53 males and only 15 females. The discrepancy might be explained by the greater liability of the male sex to syphilis, &c., but Frerichs[*] says that "the diseases which predispose to the hepatic affection by no means exhibit any predilection for males."

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[*] "Diseases of the Liver," p. 174.

As regards the organs and tissues affected by waxy disease, the following table contains the results of the 30 Edinburgh cases above referred to :—

Waxy disease in Liver, Intestine, Spleen, and Kidney occurred in 8 cases.

,,	,,	Liver, with other organs,	· ·	13 ,,
,,	,,	Intestine, with other organs,	· ·	17 ,,
,,	,,	Spleen, itself or with other organs,	·	23 ,,
,,	,,	Kidney, itself or with other organs,	·	26 ,,

In no instance was it found in the liver or intestine alone, in only one in the spleen alone, and in three in the kidneys alone. It frequently occurred with other lesions, the more common being in the intestine with tubercular ulceration, in the liver with fatty degeneration, and in the kidney with nephritic changes.

These results give as regards liability to waxy disease a predominance to the kidney over the other organs, and seem to indicate that in phthisis the waxy change tends to spread from that organ to others. This is peculiar, as Frerichs and others[*] have found the spleen and liver to be the organs most affected.

The forms of phthisis in which waxy degenerations are apt to occur are the chronic ones in which cavities have existed, and in which profuse expectoration has been a characteristic. In patients in whom there is a syphilitic history, the liability seems to be greater than in other cases.[†]

The symptoms of waxy disease are, as already stated, indefinite ; for a time, little else than pallor of the skin and mucous membranes being remarked. Not infrequently the occurrence of dropsy about the ankles and albuminuria may draw attention to it, and when the intestine is affected a more or less intractable diarrhœa sets in. The affection of the liver does not seem to produce any obstruction to the portal circulation, so that ascites is not a marked symptom. By

[*] Ruehle, Ziemssen's Cyclopædia, vol. v., p. 581. Lebert, "Klinik der Brust-krankheiten," Band ii., p. 151.

[†] Powell, "Diseases of the Lungs," 3rd edition, p. 407.

physical examination, the enlargement of the liver and spleen can easily be made out.

The effects of this waxy disease on the phthisis are, on the whole, detrimental, the loss of strength continues, and when the intestines are involved the diarrhœa rapidly increases the exhaustion. But, although this is the case, it would seem that, like other complications, it may act to some extent beneficially on the pulmonary disease. Ruehle, for example, quotes Meckel's statement, that the "tuberculosis changes suddenly into amyloid disease," and states that some abatement of the pulmonary symptoms may occur on its supervention.

As regards its treatment, nothing special need be said. Iron, in the form of the syrup of the iodide, and iodide of potassium are the main remedies, and if the diarrhœa is excessive, the nitrate of silver* enema may be tried.

The *affections of the kidney* in phthisis are, waxy degeneration, acute or chronic nephritis, and tubercular disease. Concerning the waxy disease, little need be added to what has been already said. In the 100 phthisical *post mortem* examinations already referred to, it was found 26 times, and Grainger Stewart † states that, in his cases of waxy kidney, phthisis was present in about one half. It is indicated by its insidious onset, by dropsy about the ankles, albuminuria with hyaline casts, lowered specific gravity, and usually increase in the amount of urine. Like all waxy degenerations, it is commonest in the chronic forms of phthisis.

Nephritis, as resulting in granular and fatty cortex, interstitial proliferation, shrinking, &c., is a very frequent complication. Lebert ‡ found it present in Breslau, in the proportion of 20 per cent. of the chronic cases, and in Zurich

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* 4 or 5 grs. of Silver Nitrate dissolved in 3 or 4 ounces of water or starch mucilage, and injected very slowly.

† " Bright's Disease," p. 166.

‡ " Klinik der Brustkrankheiten," Band ii., p. 151.

of 14 per cent., and notes that in the acute cases it occurred
to a very similar extent. According to the pathological
records of the Edinburgh Infirmary, it would seem to be even
more common, for, indeed, with it, and with waxy and fatty
changes, it is rare in phthisis cases to find reported in weight
and appearance, a perfectly normal kidney.

Its onset is usually insidious, increased frequency of mic-
turition, some diminution in the quantity of the urine, dropsy,
and albuminuria being the usual symptoms. It may, how-
ever, begin suddenly (4 out of 300 cases), with marked
diminution in the quantity of the urine, albuminuria, hæma-
turia, and general dropsy,* at which time an abatement in the
severity of the pulmonary symptoms may be noted. In one
such case under my charge, *post mortem* examination revealed
acute interstitial nephritis, the fatal result, however, being due
to the pulmonary lesion.

Kidney disease is said by Lebert to bear a double relation-
ship to phthisis, in that " zur chronischen nephritis kommt nicht
selten tuberculose hinzu und zu bereits entwickelten tuberculose
später interstitielle nephritis." To the latter part of this state-
ment no exception can be taken, but the statement that phthisis
frequently supervenes in patients the subjects of renal disease,
is contrary to my experience. Thus, out of 300 cases of
distinct phthisis, which, either as in or out patients, lived for
at least weeks, but usually months, subsequently to my observa-
tion, in 24, or 8 per cent., did albuminuria or other symptom
enable the existence of renal disease to be recognised, and of
that number, in 20 it was distinctly evident that the renal
had supervened on the pulmonary mischief. Of the four
cases in which the kidney disease had preceded the phthisis,
one was primary tuberculosis of the kidney, another was
associated with organic cardiac disease, a third was the result
of a nephritic attack years previously, and the fourth was

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* Grainger Stewart states that, in his cases of inflammatory Bright's disease,
phthisis existed in 7 per cent. " Bright's Disease," p. 99.

a case of albuminuria and renal disease, the result of bladder mischief.

Tubercle in the form of grey miliary granulations, most abundant in the cortex, is not uncommonly found in the kidney along with similar changes in the lungs, spleen, liver, &c., and occasionally small softened yellow nodules are met with. Such, however, are never recognised during life, so that ordinarily renal tubercle, as a complication of phthisis, presents no symptoms. It is otherwise, however, when the renal has preceded or developed along with the lung disease ; in such cases not only the kidneys, but the ureter and bladder may be found the seats of extensive tubercular mischief. The symptoms then are, severe pain extending down to the bladder, and urine containing albumen, pus, blood, and detritus, with frequent and painful micturition.

Fistula in ano is a very common complication of phthisis. It occurs, according to Powell, in about 5 per cent. of the cases, and according to Cripps and Allingham, the proportion of fistula cases with phthisis is from 10 to 15 per cent. It is much more frequent in males, it is very uncommon under 20, and the age at which it seems most likely to occur is between 35 and 45 (Pollock). In most cases it is associated with the later stages of the phthisis, but, as is well known, it may precede the manifestation of chest symptoms.

Its causation is very obscure. It has been ascribed to direct extension of, or infection from, tubercular bowel lesion, but although the discharge from a phthisical fistula shows the tubercle bacillus, it cannot be said to be caused in this way, as instances of fistula in which no intestinal mischief exists are distinctly frequent. On this subject, Pollock says, " It is a matter of observation that irritation of a portion of the gastric intestinal canal is often manifested at the extremity of a mucous tract. Of this aphthæ, co-existent at the mouth and fauces, and also at the anus, and irritation of the nostrils

in children the subjects of worms are familiar examples."*
Since tubercle tends to become deposited wherever nutrition
is impaired, we may suppose that in this we have a possible ex-
planation.   By Kelsey and Allingham, the lessened amount of
fat in the ischio-rectal fossa is regarded as an important element
in its production.   By this, as can readily be understood, the
hæmorrhoidal veins will suffer from want of support, will
become distended, and tend to rupture, a process which will
be much favoured by the act of coughing.   In this way the
affection is by these observers believed to begin as an
abscess in the submucous connective tissue, but they also
consider that a tubercular ulcer of the rectum may be its
mode of origin in certain cases.   Of further importance in
connection with its etiology, is the large number of glands
about the termination of the bowel.

The onset of fistula in phthisis is usually insidious.   The
patient, mistaking its nature, may complain of piles, or indeed
he may be led only to discover its existence by observing a
discharge.   Further peculiarities of phthisical fistula also are,
its tendency to undermine skin and mucous membrane rapidly,
and not to burrow deeply.   Its internal and external openings
are large and ragged, the latter differing much from that of a
healthy fistula, which is small and pouting.   In the phthisical
form, too, the sphincter muscle will usually be found very weak.

The bearing of this complication on the pulmonary disease
is very important from the treatment point of view.   By most
authorities, as is well known, it is looked upon as being to
a considerable extent salutary.   It has been stated, for
example, that pulmonary symptoms which have been in-
creasing, have become quieted when it has shown itself, and
that in phthisical cases, when healing of the fistula has been
brought about, the lung symptoms have become correspond-
ingly aggravated.   Further, in patients in whom phthisis has

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* In syphilis, if condylomata are present, mucous patches in the mouth are
almost sure to co-exist.

not existed, or at least not been recognised, its onset has been distinctly remarked after the healing of the fistula. Much therefore has been said against interference in those cases, and when, in addition, it is remembered that the operative treatment of fistula in phthisis is but seldom successful, the widespread disinclination to resort to it can be understood. Much however can be said on the other side. It must not be forgotten that an individual with sound lungs may become affected with fistula, in which, if not treated, tubercle bacilli may develop, and induce pulmonary tubercle by auto-infection, and that in phthisis the irritation from the fistula may be so great as to necessitate operative interference on that ground alone. The advice of many surgeons, therefore, is to operate, unless the pulmonary symptoms, and more especially the cough, are severe. Allingham points out that phthisical patients with fistula are frequently thereby thrown into a state of mental worry, the relief to which by the operation has a beneficial effect on the pulmonary disease, and he states that, when in such cases the fistula healed kindly, he never saw the patient the worse for it. With the view of obviating the evil effects of the confinement after operation, he recommends that it should be performed in a season, or at a place, when or where the patient can venture out of doors shortly after it.

For similar reasons, Cripps has recommended the elastic ligature instead of the operation, as then the patient need not be kept in bed.

Smith, besides referring favourably to those plans of treatment, states that, in a case of extensive lung disease under his care, after the healing of the fistula, the patient kept up a discharge by a pea issue in his arm. The weakened condition of the sphincter has also been referred to, and Kelsey advises that, in operating, it should be interfered with as little as possible, so as to avoid the risk of its resulting incompetence.

In addition to fistula, it is worthy of note that tubercular ulcers may be met with in the rectum, near the verge of the

anus. Reference to these have been made in Kelsey's work, and it would appear that, like tubercular mischief elsewhere, these lesions may exist before any general manifestation of tuberculosis. Such an ulcer may end in fistula, and the instance has been reported of a child, the subject of acute tuberculosis, in which one such caused sudden death from hæmorrhage. (Ashby, *Brit. Med. Journal*, July 31, 1880.)

CHAPTER VIII.

OTHER SYMPTOMS AND COMPLICATIONS OF PHTHISIS.

THE close etiological association of pleurisy and phthisis has been alluded to at page 58 ; what here only has to be considered is how a phthisis, whether developed after a pleurisy or not, may become complicated by pleuritic processes ; what are the symptoms which ensue ; what are the results of the complication, and how we may best act so as to alleviate the patient's condition.

The adhesions of affected apices found on *post mortem* examination demonstrate that pleuritic processes are more or less constantly going on in cases of phthisis, and the connections between the interstitial and subpleural connective tissues and the lymphatic vessels connected with them afford for this a ready explanation. Bearing this out further, it is found that the amount of mischief in the lung and the amount of adhesions are usually in proportion, and that the lung most affected is that in connection with which the adhesions are greatest. As already stated, however, symptomatic indications of these pathological changes are but slightly marked, pain, the usual symptom of pleurisy, being conspicuously slight. For this the explanation is in part no doubt that given at page 179, that the movement of pulmonary against costal pleura is at the upper portions of the lungs very slight; but in part also, as every one engaged in examining numbers of hospital patients knows, because pleuritic processes, as denoted by friction sounds, occur very frequently unaccompanied by any symp-

toms whatever. As a complication, therefore, such a pleurisy requires no further consideration.

The pleurisy, however, which occurs over lung tissue where it is comparatively healthy requires more careful study. In such cases the part usually affected is the same as in an ordinary pleurisy, that is to say, the part corresponding to the lower and antero-lateral region of the lung, and the pain and other symptoms induced by it are usually distinctly marked. Indeed, it has not infrequently happened in my experience that such pain, by causing patients to seek medical aid, has led to the detection of a previously existing, but to the patient unknown, phthisis.

The cause of such a pleurisy may be supposed to be the same as it is in individuals who, though not suffering from the disease, are yet phthisically disposed, or who are the victims of a debilitated or a depraved constitution, viz., some trifling cold or exposure, but very frequently anything of the nature of an exciting cause cannot be detected. The formation of tubercle nodules in the pleura seems also to be a cause of pleurisy. In discussing this, however, a difficulty arises, because it is often impossible to say whether the tubercular nodules have caused the pleurisy, or the pleurisy being the primary, tubercle nodules have formed in the inflamed and weakened tissue. The *post mortem* appearances in acute miliary tuberculosis, where, with numerous nodules, the pleura often appears clear and transparent, seems to militate against the former view by indicating that tubercle nodules in themselves are not specially irritating. But there is little doubt that such an origin may obtain. In children, Rilliet and Barthez, allowing that the inflamed surface and false membranes of a pleura may readily become the seat of tubercle, still assert strongly that tubercle may be the primary cause of the inflammation, and in abdominal phthisis or tubercular peritonitis the diaphragmatic and basal pleurisies which occur and lead to basal phthises may be conceived to be due to

tubercular deposit in the pleura, as the result of resorption through the diaphragm.

In whatever way induced, pleurisy is an extremely common complication of phthisis, from which follows as a deduction a peculiar tendency in it to recur and attack the two sides of the chest alternately. To such an extent is this the case that in patients in whom pleurisy occurs frequently or alternately, although no physical signs of phthisis can be detected, its existence may be strongly suspected.

The symptoms of pleurisy as a complication of phthisis are much the same as those of an ordinary pleurisy, excepting, perhaps, in their greater tendency to latency, its existence in the phthisical being with special frequency discovered only by the physical signs of increasing effusion presenting themselves. In other cases pain, along with an aggravation in the fever, leads to its detection in an early stage.

The pleurisy of phthisis is, however, usually dry, and results directly in adhesions; but effusion may occur terminating indirectly in adhesions; and, further, it may end in tubercular deposition, with or without effusion as an intermediate. On the subject of effusion Lebert gives the following statistics : —Frequency in the chronic form, 10 to 12 per cent., of which in five-sixths the effusion was sero-fibrinous, in one-sixth purulent, more common on the left side. Frequency in the subacute form, 20 per cent., in one-fourth of which the effusion was purulent, more common on the left side. Double effusion more frequent in the subacute than in the chronic form.

The effects of this complication on the phthisis itself are specially interesting. The slighter and fortunately by far the commoner forms which end directly in adhesions may be looked upon as being, apart from the pain and irritation which is entailed upon the patient, altogether salutary. As Pollock* has said, "they are plainly the natural means of limiting, circumscribing, and walling the disease in the lung. They are the

* "Elements of Prognosis in Consumption," p. 328.

safeguard against perforation," and, as stated by Dr Alison, " if the progress of a cavity be to the surface, these barriers interpose in a most effectual manner an obstacle to such advances of local mischief."

The effects of effusion in phthisis are to be regarded as of more serious import, for in many cases it seems directly to hasten the fatal termination by adding to the patient's distress and dyspnœa. But it is equally certain that to it also a salutary aspect may be discovered, for it is to be remembered that an effusion, by allowing to a greater or less extent lung collapse, may permit cavities to close, and afford diseased foci in the lung an amount of rest which, with ordinary physiological use, they could never have obtained. Broadbent * has pointed this out, and as something further in favour of this salutary effect of effusion, mentions, while allowing that the cases are not exactly parallel, that in acute miliary tuberculosis a lung collapsed and compressed by fluid seems thereby to escape the tubercular process. Clinically examples of amelioration and arrest after pleuritic effusion are not uncommon, and the occurrence of fatal hæmoptysis † and of pneumothorax ‡ after tapping an effusion in a phthisical subject is always a risk which must be fully considered in its treatment.

The proportion of cases in which the pleurisy of a phthisical patient ends with or without effusion in tubercular change, cannot well be ascertained, since, as already stated, it is so difficult, clinically or by *post-mortem* examination, to determine which has been the primary mischief. That this termination to a pleurisy frequently occurs, however, there can be no doubt, and, indeed, this morbid change may occur even in the absence of lung tubercle. Thus, Lustig§ gives a

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* *Lancet*, May 31st, 1884.

† Fræntzel, Ziemssen's Cyclopædia, vol. iv., p. 711.

‡ An example of this was reported to me by Dr Brakenridge.

§ Wien. Med. Wochenschr., 1884, p. 52.

case in which, as the result of an injury, pleurisy with effusion occurred, and terminating fatally, showed on *post mortem* examination tubercular nodules over the pleura and false membranes, the lungs themselves being absolutely free from such mischief, whilst Lebert * mentions one case, in which pleural tubercle occurred with but slight affection of the lung itself. He also quotes three cases from Wagner (das Tuberkel ähnliche Lymphadenom, Leipzig, 1871), in which there was miliary tubercle of the pleura, without the lungs being involved. But when the lungs are affected, and specially in the tubercular forms of phthisis, such a termination is far more frequent. In these cases there may be comparatively little fluid effused, but the dulness caused by it, or by the thickened pleural membranes, does not readily disappear, and the physical signs of involvement of the neighbouring lung tissue itself in the tubercular process frequently supervene. In other cases, there may be a considerable amount of effusion, and, as is well known, this is apt to be hæmorrhagic in character.

The symptoms denoting that in a phthisical individual, a pleurisy has terminated in this tubercular change, are not always equally distinctive. In a patient with extensive pulmonary, and perhaps laryngeal tubercle, but little symptomatic of aggravation in the general downward course of the disease may be noticed. In one, on the other hand, who, though suffering from phthisis, yet retains a considerable amount of vitality, the supervention of tubercular disease in a pleuritic attack is to be suspected, if the temperature and pulse rate remain high, if the fluid takes a long time to disappear, if it is hæmorrhagic in character, or if the evidence of breathlessness continues out of proportion to the extent of pulmonary mischief.

The treatment of the slighter forms of pleurisy in the phthisical is a simple matter, a small blister over the affected

* " Klinik der Brustkrankheiten,". Band ii., p. 23.

spot, a flannel bandage or strapping to procure rest, and a little iodide of potassium with or in addition to the cough mixture being usually all that is required. When, however, there is a considerable amount of effusion, the case is different, and, remembering that, on the one hand, the fluid may act beneficially by affording rest to the lung, and permitting contraction and cicatrisation to occur, and on the other, injuriously, by debilitating the patient and affording in the thickened false membranes a nidus for tubercular deposition, the problem which the physician has to solve as to aiding in its absorption is always a difficult one. On this subject, Broadbent's advice is, to " tap early, unless it is the affected lung which is compressed by the fluid," advice which certainly recommends itself. My practice is, when the effusion is in the affected side, to let some time elapse, using iodine, small blisters, or the inunction of the red iodide of mercury ointment, and iodide of potassium internally, and when tapping appears to be advisable, to use the smallest size of aspirating needle, and removing only some six or eight ounces at a time, to watch its effects, and be prepared to repeat it in a few days, if necessary. As regards the exact time for such interference, cases must be judged of individually, but, by following some such plan the benefits of the effusion can be best secured to the patient with the least risk of harm from interference. Lastly, phthisical cases with pleuritic effusion may, when absorption is tedious, be bettered, if not kept too long, or too continuously in bed. Absorption is often aided by movement, and if the patient inclines to get up, and if the effusion is not great, this should certainly be permitted, care being taken to watch the result, and act accordingly.

Pneumothorax in a work on phthisis should, it might appear, be considered as a complication of that disease alone. As however it results from other causes, and as, although in the majority of instances, that it has been caused by phthisis is easily made out, yet cases are met with in which its occurrence

cannot so clearly be ascribed to that disease, a diagnosis can only be made, and a plan of treatment decided upon, after a full consideration of the other pathological conditions which may lead to its production.

What those are, may be well seen in the following table quoted from Saussier by Fræntzel.*

In 131 cases pneumothorax occurred—

From Pulmonary Consumption, . . .	81	times.
,, Empyema, ...	29	,,
,, Gangrene, ...	7	,,
,, Pulmonary Emphysema, . . .	5	,,
,, Pulmonary Apoplexy, ...	3	,,
,, Hæmatothorax, ...	1	,,
,, Hydatids, ...	1	,,
,, Abscess in the Lung, ...	1	,,
,, Cancerous Ulcer, ...	1	,,
,, Hepatic Fistula, communicating with lung,	2	,,

This certainly gives a too small proportion to pulmonary phthisis, and is probably due, as stated by Walshe, to the fact that "tuberculous perforation is relatively speaking an every day affair, which passes unrecorded; perforations from gangrene, vesicular emphysema, hydatids, pulmonary apoplexy, abscess, and other very rare causes, are greedily caught hold of, and registered. The number of the latter published, consequently gradually swells out of proportion with their actual comparative frequency." Fræntzel indicates that, out of 15 cases of pneumothorax, one at most will be due to causes other than phthisis, and out of the last 15 fatal cases which occurred in the Royal Infirmary of Edinburgh, 13 were due to phthisis. We must also remember that, with apparently healthy lungs and pleura, powerful respiratory movements, such as are entailed by exertion, have been said to cause rupture of air cells, and give rise to pneumothorax.

* Ziemssen's Cyclopædia, vol. iv., p. 745.

Fræntzel* relates a case of this kind as occurring in a lad of 19, when overtaxing his strength in rolling a heavy barrel ; Vogel† also, in a woman during a bronchitic paroxysm ; and Dr Brakenridge has informed me of the occurrence of pneumothorax in a young man, when making a powerful expansile movement of his chest. Although in such cases the pneumothorax disappears in a few weeks, and the lungs subsequently shew no signs of disease, one should always contemplate the possibility of the existence then of small cavities or softened foci.

The proportion of phthisical cases which die of pneumothorax, is about 5 per cent.‡   Of the sexes, the male is more liable.   Pollock, out of 20 cases, gives 12 male and 8 female. Out of 13 fatal cases of phthisical pneumothorax in the Edinburgh Infirmary, only two were women.   Associated with the fact that phthisis is as common, if not more so in females, this relative liability of males is noteworthy, and is probably due to the risk of -rupture, which the greater amount of physical exertion entails in man.   It is also most prevalent in young adults.   Of Pollock's 20 cases, 14 were under 25, and 45 was the greatest age.   Of the 13 Infirmary cases above mentioned, all were under 35.   In children pneumothorax is very uncommon.   It does however occur as the result of phthisis as in adults, but more frequently by abscess, or by whooping cough, or by empyema opening into bronchi.   Phthisical pneumothorax, in the experience of Walshe, Copeland, Louis, West, Powell, and most others, is more common on the left side ; in that of Laennec and Pollock, on the right.   This point, however, is unimportant, but it is to be remembered that two cases of double pneumothorax have been noted by Laennec.

Of more consequence is the locality in which pleural per-

* Ziemssen's Cyclopædia, vol. iv., p. 746.

† Deutsches Archiv für Klin. Med. ii., p. 244, 1866.

‡ West, quoted by Douglas Powell, " Diseases of the Lungs," 3rd Edit., p. 131.

foration is most apt to occur, and the form of the phthisical disease which most readily gives rise to it. As regards locality, the upper part of the lung is, as might be expected, its most common seat. Copeland gives near the angles of the third or fourth ribs; Walshe, the area between the third and sixth ribs. Pollock states, of his twenty cases, that in eight it was at or above the level of the second rib; that in one there were two perforations; in another, several; and that in the remaining nine, the point of rupture could not be found. Haughton, in Lænnec's work, states that the inferior part of the upper lobe, or the superior part of the lower, is the most usual seat; and Stokes, that the greater number of ruptures occurs rather towards the middle than towards the apices of the lung. Lastly, of the four cases of phthisical pneumo-thorax in children, reported by Rilliet and Barthez, it is interesting to note that, in three the perforation had occurred in the inferior lobe. From all this, it may be concluded that, in phthisical pneumothorax of the adult, the perforation is most likely to occur in the upper half of the lung. [This may be of importance practically. Thus, in a case of pneumo-thorax with moderate fluid effusion, which was under my care, in which a distinct history of the pre-existing malady could not be obtained, it aided the diagnosis. On aspirating in this case, air could be heard bubbling up, shewing that the opening was below the level of the fluid, a fact which led to the diagnosis of gangrene, and exclusion of phthisis as its excit-ing cause.]

As to the form of the phthisical disease in which pneumo-thorax is apt to supervene, there is a difference of opinion, some, as Niemeyer and Powell, regarding the more acute, others, as Stokes and Fræntzel, regarding the more chronic as presenting the greater liability. Further, reasons for these diverse opinions are not wanting. Thus Niemeyer, in support of his opinion, states that, in acute cases, pleural adhesions, which of course would have prevented rupture, have not had

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time to form ; and Stokes urges that, inasmuch as the greater number of perforations are not at the apices of the lung, the rupture must be associated " less with the first or second than with subsequent developments of the·disease."

Any lengthened discussion on this point would be useless. Whether the disease be acute or chronic, we should remember, first, that the formation of the cavity, the walls of which have given way, must have taken place so rapidly as to leave no time for pleural adhesions ; second, that as the intrapulmonary pressure will be greater in individuals moving about, perhaps at work, than those in bed, the risk of rupture will be greatest in the but slightly advanced cases ; thirdly, that of the two lungs, pneumothorax usually occurs in the one less diseased ; and fourthly, that in long standing cases of fibroid phthisis with adherent pleura, there is much greater risk of the rupture of a blood vessel into a cavity, than of a cavity into the pleura.

The gas in the pleural cavity is somewhat similar in composition to expired air containing 80 to 90 per cent. nitrogen, 6 to 8 per cent. carbonic acid, and 2.5 to 5.5 oxygen. Its entrance into the pleura almost always induces fluid effusion, but although it seems to be sufficiently irritating to do this, the gas and fluid are not usually fœtid. Of course when, from the rupture of a phthisical vomica, decomposed tissue elements and secretions enter the pleura, this character may be induced, but fluid and gas containing sulphuretted hydrogen and other gaseous and liquid products of decomposition, are associated rather with cases of pneumothorax, the result of gangrene, abscess, or empyema, than with those of phthisis.

The effects of the supervention of pneumothorax in a case of phthisis, are usually such as to cause death, in a period varying from a few minutes to a few weeks ; but a consideration of the circumstances under which this complication may occur, demonstrates that they must vary in their degree of severity within very wide limits. Thus, coming on as it very

usually does in the somewhat less diseased lung of a patient exhausted by extensive phthisical mischief, it is likely to be almost immediately fatal from asphyxia and syncope, the possibility of the patients' surviving a few days depending mainly on the chance of pleural adhesions existing, and being sufficiently strong to render the pneumothorax an incomplete, partial, or localised one. In the case, again, of a less debilitated individual, it may occur to the extent of permitting almost complete collapse of the lung and great cardiac displacement, and yet its immediate effects be recovered from, the patient subsequently developing pleurisy with effusion, and dying ultimately of exhaustion.

The severity of the immediate symptoms may also be influenced by the nature of the perforation. Should this be valvular, that is to say, should it permit air to get into the pleura with inspiration, and prevent its exit in expiration, great and continually augmenting intra-pleural tension may so interfere with the action of the heart and opposite lung, as to cause a fatal result, if not obviated by pleural puncture.

Similarly the secondary effects of pneumothorax may be influenced by the character of the fluid effused in the pleurisy which ensues. As stated already, in the majority of phthisical cases this is not fœtid, and the constitutional symptoms, due to the resorption which occurs, are not very severe. However, as the result of putrid or decomposing matter entering the pleural cavity with the air, should the fluid be very fœtid, adynamic symptoms, collapse, and death are apt rapidly to supervene. In a case, lastly, where the phthisical lesion is very slight, and where the development of the pneumothorax may be looked upon as being to some extent accidental, a mishap the result of, let us suppose, a cavity having formed close to the surface of the pleura, and of the patient's having undergone at the time some exertion, and so caused its rupture, the immediate effects, though severe enough, may be all that are met with. Pleurisy, with its attendant effusion,

either does not develop at all, or if it does, is so slight as to evade recognition, the air becomes gradually absorbed, and after some days or weeks of collapse, the lung expands, and the patient is restored to complete health. Cases so fortunate are rare, not however to such an extent as might be supposed, for there is no doubt, that in many of those favourable cases in which the occurrence of pneumothorax has been ascribed simply to exertion, a small phthisical lesion has existed.

This leads to another consideration, namely, the salutary aspect which pneumothorax, like others of the phenomena and complications of phthisis, must be regarded as presenting. Though alluded to by Walshe, Pollock, Stokes, Powell, and others, Copeland is perhaps the observer who expresses himself most decidedly on this matter. He says, " My experience leads me to conclude that, when the tuberculous disease is limited, when perforation occurs at an early state of that disease, and when the constitutional powers of the patient are not much impaired—circumstances in which perforation rarely takes place—then life may be prolonged for a considerable period, if a cure even may not be effected. For it is not impossible for a superficial tubercle, or very small cavity, to perforate the pleura, and by such perforation, or the rupture of the nearly perforated pleura, to allow the passage of air into the pleural cavity, the compression of the lung, and the exudation of lymph upon the surface of the perforated membrane, favouring the diminution or obliteration of the cavity, and the occlusion, or even the cicatrisation of the aperture." Apart from the cases such as those we have just quoted, in which no effusion followed the perforation, and in which it might be affirmed that no phthisical lesion existed, cases of pneumothorax undoubtedly causing more or less complete arrest of the phthisis, have been again and again reported. Niemeyer* mentions one such, but perhaps the most striking is that quoted by Stokes, in which, though air and fluid re-

* " Text Book of Practical Medicine," vol. i., p. 280.

mained in the chest, the patient presented for a long time all
the appearances of vigorous health. Indeed, so strongly has
this salutary aspect of pneumothorax been regarded, that pro-
posals to treat phthisis by artificially inducing it, have again
and again been made.

Having now considered the primary and secondary effects
of pneumothorax, its symptoms can be easily understood.
The patient, frequently during coughing, experiences a sharp
pain in his side, as if something had given way, and from the
collapse of the affected lung, congestion of the opposite one,
and probably also from traction of the heart to the opposite
side, extremely marked symptoms of dyspnœa shew them-
selves. When seen, he is usually sitting in bed, bent forward,
with the elbows resting on, or the hands grasping, the knees ;
his manner betokens the greatest anxiety ; his voice is
feeble, husky, or absent ; and speech, cough, and expectoration
entail great effort, owing to the lessened air space. Pain is
almost always complained of, and may be due to strain upon
the diaphragm, to stretching or tearing through of pleural
adhesions, or to irritation of the pleural surfaces, by the escap-
ing air and secretions. With all these are associated a rapid
thready pulse, coldness of the extremities, clammy skin, and
other signs of shock. Many cases are fatal in this primary
state of dyspnœa and collapse. In other instances the
collapse may be to some extent recovered from. The
dyspnœa, however, continues, and in a few days or weeks
increases, as the result of pleuritic exudation ; the temperature,
subnormal in the collapse stage, rises, fever and hectic come
on, the urine is scanty, loaded with urates, and perhaps
albuminous, dropsy shews itself, and either from œdema of
the lungs or exhaustion, death occurs. Such are the usual
symptoms and phenomena of this complication. As will be
understood, however, from what has been already said, they
must vary greatly in different cases. Detailed account of
such variations need not, however, be given.

The physical signs denoting the occurrence of pneumothorax are, on inspection, dilatation of one side of the chest, obliteration of its intercostal spaces, immobility of its wall, and visible displacement of the heart's impulse ; on palpation, corroboration of the facts ascertained by inspection, and deficiency of the vocal fremitus over the affected side. By percussion, a low pitched tympanitic note is elicited, and not only is it readily to be distinguished from the normal note by its character, but its extent is characteristic. If the pneumothorax is on the right side, it reaches too far downward, owing to liver displacement ; if on the left, too far forward, owing to displacement of the heart and mediastinum. It is to be remembered, however, that the chest wall may, like Savart's tense membrane, refuse to vibrate to percussion, as the result of great intrathoracic tension in valvular perforations, or of increasing pleuritic effusions, in which case a dull note results ; that, where effusion exists, a dull note will also be produced, varying in position with that of the patient; and that, in proximity to the spine posteriorly, or wherever adhesions exist, the characteristic tympanitic note of pneumothorax is absent.

On auscultation, the signs are also somewhat variable. Where there is extensive collapse of lung, the respiratory murmur and voice sounds will be feeble or absent ; but where, with some bronchial tube or cavity remaining open, there is a covering of lung tissue not too thick to prevent transmission of sound vibrations from these to the air in the pleural cavity, the respiratory murmur, voice sounds, and accompaniments will take on an amphoric character. Where, again, lung tissue and chest parietes are, as the result of adhesions, still in contact, the breath sounds may be simply harsh in character. By auscultation and simultaneous percussion with coins, a peculiar and very distinctive ringing sound is heard where air is present. When fluid exists with the air, the Hippocratic succussion note is to be looked for. As, further, pleuritic

adhesions are most likely to occur at the upper part of the lung, and as in pneumothorax the collapsed lung remains still in contact with the chest wall, along its posterior border, it will readily be understood that the characteristic physical signs of the complication will most readily shew themselves at the lower and antero-lateral regions of the chest. Lastly, it is to be remembered that, in cases of pneumothorax with extensive adhesions, the physical signs may not shew themselves markedly at the first examination. There is no doubt that, after a time, and without any obvious change in the symptoms, rupture or stretching of these adhesions occurs, and a subsequent examination, *e.g.*, twenty-four hours afterwards, will elicit physical signs as characteristic as those obtained at first were indefinite.

The immediate treatment of pneumothorax is to soothe the nervous system, relieve the congested lungs, and strengthen the overtaxed heart, and remedial measures directed to one of these ends will act beneficially on the others as well. Thus, nerve sedatives not only alleviate the effects of the shock and pain, but, by rendering the nerve centres less irritable, enable them to bear a less oxygenated blood supply, and to demand a lessened activity from the respiratory and cardiac mechanisms. The relief of the congested lungs not only enables the tissues in general, and the nerve centres in particular, to get more of the required oxygen, but relieves the tension of the right ventricle, whilst cardiac stimulants improve pulmonary and nerve centre blood supply. In all cases, these three conditions requiring treatment are to be borne in mind; in individual cases, however, they vary as regards importance, according as cardiac failure, dyspnœa, or pain seems most urgent. A combination of ammonia and morphia is almost always indicated, the proportion of each varying as cardiac failure or pain is the more pressing, and for relief of the dyspnœa, dry cupping is probably the best remedy. Venesection is seldom admissible, but where the the dyspnœa is becoming

extremely urgent, the occurrence of increasing intrathoracic pressure on the affected side, from the effects of the respiratory movements acting on a valve-like perforation, should be looked for, and puncture practised, if necessary. The puncture may require to be repeated, but it would seem that, just as with pleuritic effusion, the exit of an excess of air aids absorption of the remainder. It will be readily understood that this should be simple puncture, not aspiration, as the latter would tend to re-open the perforation. When the most urgent symptoms are over, care must be taken to maintain the patient's strength, the diet must be highly nutritious and digestible, and in as small bulk as possible, so as to avoid anything like stomach distension and consequent interference with the action of the diaphragm. The state of the bowels is very important. A daily evacuation by laxatives or enema, not only allows freer play to the diaphragm, but as a derivative from the pulmonary to the portal circulation, it relieves pulmonary congestion and dyspnœa. The subsequent pleurisy is to be treated in the usual way, and as the liquid effusion accumulates, the increase of intrathoracic tension, displacement of heart, and consequent respiratory embarrassment, will require careful attention.

In cases of pneumothorax, the question of operative treatment by paracentesis has often to be considered. Of course, in the early stage, where, from a valvular opening, air is becoming pent up in the pleural cavity, or later, where, as the result of fluid collecting, respiratory trouble is being caused, puncture is immediately indicated ; but when no urgency of this kind exists, it becomes a question, as to whether or not a permanent opening into the pleura would be beneficial. In favour of it, are many considerations. For example, we must remember that it is indicated when a pyothorax or empyema becomes, owing to rupture into a bronchial tube, a pyopneumothorax,—a state of matters very similar to that under discussion;—also that, with antiseptic precautions, there would seem less risk from the

free entrance of air into the pleural cavity through an opening in the chest wall, than from the entrance of air and noxious matter into it through the perforation. On the other hand, it must be admitted that the affected lung may be better off with an intact chest wall, than with an opened one, for a certain amount of intrathoracic tension, or, at any rate, air in a completely closed space, may be favourable, as affording to the lung an elastic support during coughing, &c. Again, it is to be remembered that patients with pyopneumothorax may live for years, when resorption of pus, &c., is prevented by thickening of the pleura. Finally, it would seem that, practically, this mode of treatment has not been very success-ful, Stokes having pointed out that extensive gangrene of the pleura is apt to follow it. With antiseptics at our disposal, however, the results might be different, but I have not had the experience which would warrant the expression of a decided opinion on this matter.

If, however, with symptoms of blood-poisoning, the fluid is found on exploratory puncture to be fœtid and crowded with micro-organisms, a permanent free exit is absolutely indicated, and affords at least great temporary relief. But before per-forming this operation, it is necessary to make sure that the lung is completely retracted, as if not, the making of a free incision would, by permitting its further collapse, lead to respiratory embarrassment. This can easily be ascertained by connecting with the rubber tubing of an ordinary chest trocar a piece of glass tubing. On introducing the trocar into the pleura, after placing the end of the glass tube under a solution of boracic acid or other antiseptic, and raising the latter to the level of the patient's chest, the exit of fluid from the chest, or the rise of the solution in the tube, readily reveals the state of the lung.

Laryngeal Phthisis.—Affections of the larynx in phthisis are so extremely common that it has been said (Gottstein) that a phthisical patient rarely has a normal larynx, a statement which,

a consideration of the gross departures from the normal state which the pulmonary disease entails in all parts of the respiratory tract, readily enables us to understand. Fortunately, however, these laryngeal troubles in phthisis are not all equally severe, and in a general way they may be divided into simple and tubercular, the former comprising anæmia, paresis, paralysis, and catarrh; the latter, tubercular infiltration, ulceration, and more or less extensive destruction of tissue. Whilst if both these forms are taken together, it is rare to find a normal larynx, the more severe tubercular changes are much less frequent. Thus Schäfer found in 100 cases 64·6 non-tubercular, 32·8 tubercular, and in 2·6 the larynx free from disease.*

The age at which laryngeal phthisis is apt to occur is much the same as is the case with the pulmonary disease, viz., between twenty and forty, and it would seem to be markedly less frequent in children. Thus it is interesting to remark, that while the proportionate number of deaths from phthisis between birth and the eighteenth year seems to average about 9 per cent. of the whole, Heinze † found only 2·3 per cent. of laryngeal phthisis in children under nine. Men are more prone to it than women, and this disproportion seems to hold good in the case of the severe tubercular forms even more than of the nontubercular. In connection with this, the rather greater liability of the female sex to consumption, and the greater liability of the male to all kinds of laryngeal affections, are points of interest.

The question as to whether tubercular disease can occur primarily in the larynx, that is to say, apart from and independent of similar disease in the lungs, might seem hardly appropriate for consideration in a chapter on the laryngeal complications of phthisis. It is, however, of great interest and of practical importance, as it often happens that the laryngologist in doubt as regards a laryngeal case, and the

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* Gottstein, " Diseases of the Larynx," translated by M'Bride, p. 202.
† Gottstein, *ibid.*, p. 203.

physician suspicious about a hoarse voice, desire mutual aid. Opinions on this matter appear, however, pretty equally divided, the difficulty in coming to a conclusion being similar to that already referred to in connection with cases of hæmoptysis or pneumothorax, viz., the practical impossibility of determining by symptoms or physical signs the existence of very slight tubercular deposit in the lungs.

The balance of opinion, however, is apparently in favour of there being a primary laryngeal tubercle,* but it is to be remembered that such cases are extremely rare, and that in the great majority of cases of laryngeal phthisis which come under the physician's care, the lung lesion is well advanced before the laryngeal mischief has shown itself. Indeed, to such an extent is this the case that, as is well known, Louis held the view that the laryngeal complication was the result of infection from the sputum.

The pathological changes in the non-tubercular forms of larynx affection in phthisis vary, but in a general way may be divided into three classes, (1) anæmia, with or without paresis of the adductors and tensors of the chords; (2) right sided recurrent paralysis; and (3) catarrh.

Of these the first is by far the most common. Laryngoscopic examination then shows distinct pallor and anæmia, most marked at the entrance of the larynx and epiglottis, with a few solitary vessels coursing over the pale mucous membrane. It is noteworthy, however, that, as Semon has pointed out, the mucous membrane, after manipulations with the laryngoscope, may become reddened and flushed, and thus obscure the characteristic pallor. Paresis of both cords may co-exist, so that the glottis either remains open on attempts at phonation (paresis of adductors) or is elliptical (paresis of tensors).

The second form, right-sided paralysis of the glottis, is less common, and is due to traction upon and impaired function

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* Gottstein's " Diseases of the Larynx," p. 203.

of the right recurrent laryngeal nerve by the cicatricial contraction of a phthisical right upper lobe. By the laryngoscope it is easily recognised, the immobile cord being either in the cadaveric position or in the middle line. If in the latter position, phonation may be perfect, hence the condition may be only detected by the laryngoscope.

In the third form, viz., catarrh, examination shows the ordinary appearances of this condition. There is found redness and swelling of the arytenoids, interarytenoid commissure and ventricular bands, with the secretion, increased in quantity, adhering as small pellets to these parts, or forming threads between the chords.

In the true tubercular form, the primary pathological change is tubercular infiltration. This usually begins at one point, and is most common on the aryepiglottic folds and ventricular bands. It does not usually begin on the epiglottis, indeed it has been said that it does not occur here at all without other parts also being involved. But tubercular deposits do not long continue as such. Consisting as they do of masses composed of cells embedded in a reticular substance and situated in the subepithelial tissue, the superjacent epithelium becomes raised, loosened, and torn, and perforation having occurred, and the softened tubercle escaping, ulcers are formed. These, by successive deposition and softening of tubercular matter in their walls, become wider, and by the involvement of the underlying subepithelial tissue and perichondrium, become deeper. The cartilage itself frequently becomes diseased, either owing to the destruction of the perichondrium interfering with the nutrition, or to tubercular cells penetrating its intercellular substance.

The laryngoscopic appearances in this tubercular form vary considerably. Tubercular infiltration is most commonly seen over the arytenoid cartilages, and occasionally in the epiglottis. It is always characteristic, specially so when over the arytenoids. The aryepiglottic folds then tend to assume a

pyriform shape, the broad end of the pear corresponding to the arytenoid cartilages, and the swelling is pale grey in colour, quite different from œdema on the one hand or inflammatory swelling on the other. Not infrequently it is covered with small yellow patches, which are described as presenting a bacon-like appearance. In the ulcerative stages the laryngoscopic appearances are usually ulceration over the thickened arytenoid cartilages, ulceration of the ventricular bands or of the vocal chords themselves, specially about the vocal processes, ulceration and swelling of the under surface of the epiglottis.

As a clinical fact, however, infiltration and ulceration usually occur together.

The differential diagnosis of these laryngeal changes now requires consideration. It is to be borne in mind that infiltration and ulceration in the larynx may be tubercular, syphilitic, or malignant, rarely due to lupus or leprosy. In tubercle, the infiltration is smooth and pale grey in colour, and its favourite seats are the arytenoids. The ulcers are formed slowly, and are usually found on the arytenoids, laryngeal surface of the epiglottis, ventricular bands, and posterior wall of the larynx. The ulcers are thus often multiple, and some observers state that they are seen with the laryngoscope to be surrounded by miliary nodules of a yellow colour. In syphilis, the infiltration has a red, inflamed appearance, it breaks down rapidly, and the ulcer is usually single. Its favourite seat is the edge and upper surface of the epiglottis. In malignant disease, the appearance is much more like syphilis than phthisis.

It must further be borne in mind that laryngeal tumours of tubercular structure have recently been described by several observers, and that lastly there is a form of laryngeal neoplasm which, although not tubercular in structure, is when present more or less pathognomonic of phthisis. This is a sessile, sharply defined growth, arising from the interarytenoid commissure. There can be no doubt that clinically the existence of such a well-defined neoplasm in this situation

should arouse the strongest suspicion either of the presence of tubercular disease or of its subsequent development.

Can a non-tubercular affection of the larynx lead to ulceration? There seems little doubt that a catarrh may entail superficial loss of epithelium and a certain amount of erosion, but it seems to be the case that deep ulceration cannot be brought about in this way, that is to say, without tubercular deposition. Inasmuch, however, as a simple catarrh of the organ, by lowering its vitality, may predispose it locally to the tubercular process, the association of catarrh or simple anæmia with tuberculosis is of great importance clinically.

The symptoms of laryngeal affection in a phthisical subject will, it is obvious, vary according to the nature and extent of the pathological changes in that organ. Of them all, change in the character of the voice is naturally the most prominent. This may manifest itself as a slightly perceptible hoarseness, as complete aphonia, or as a condition where hoarseness is usual, but in which phonation can be brought about by an effort, and between these all degrees of change in vocalisation can be recognised. With this symptom there may be associated a feeling of tickling or itching in the throat, or a complaint that the voice is easily fatigued. In severe cases, where there is complete aphonia, this fatigue is very apparent, the husky voice requires a strong expiratory blast for its production, and such patients appear when speaking, or rather whispering, to be very much out of breath.

Although, as a rule, the degree to which the alteration in the character of the voice occurs varies proportionately with the degree of severity of the laryngeal affection, being slight in the non-tubercular and marked in the tubercular forms, it is to be remembered that marked hoarseness or complete aphonia may exist in cases of catarrh or anæmia with paresis of the cords, or in the right paralysis of the cords; and that in the earlier stages of the tubercular disease the alterations in the voice may be slight. The degree of vocal disturbance

necessarily depends greatly upon the locality of the lesion, being greatest if the chords or their insertions into the vocal processes be involved, or when the interarytenoid growth prevents approximation. To come to a conclusion, therefore, as to the nature or gravity of the lesion from the hoarseness as a symptom, is in most cases impossible. The subsequent course of events will demonstrate as to which form of laryngeal disease obtains : if tubercular, it becomes aggravated ; if simple, it disappears or remains stationary ; but in almost all cases a laryngoscopic examination is of the greatest value. On this subject statistics are of interest. Thus in 500 cases of laryngeal phthisis examined laryngoscopically by Morell Mackenzie, disturbance of voice was present in 92 per cent. ; and of these 24·6 suffered from aphonia and 67·4 from dis-phonia. In 100 cases of pulmonary phthisis in which there was no tubercular infiltration of the larynx, he found perma-nent or occasional hoarseness in 37.

Difficulty in swallowing is another symptom of the laryngeal complication in phthisis, and it also varies in degree. In slighter cases, it shows itself as a pain in the throat when the act of deglutition is performed, often shooting up towards the ear ; in severe cases, such agony and distress from coughing are produced whenever swallowing is attempted, that the patient refuses all food, solid, fluid, or semi-fluid. Its occur-rence almost always denotes that tubercular disease of the larynx exists, and that certain parts are specially affected. These are the tissues covering the arytenoid cartilages and epiglottis, parts which are certain to be irritated by the passage of food from the mouth to the gullet, or by pressure of the pharyngeal muscles when deglutition is performed.

The cough of phthisis is usually aggravated by the laryngeal complication, and when the lung mischief is slight the laryngeal condition may seem to be its main cause. It is then short and specially dry in character, indicating that, as the result of hyperæsthesia, it is in excess of its requirements. In the

advanced stages, when, owing to destruction of the chords, closure of the glottis cannot take place, the cough, husky in character, becomes very distressing. This is due mainly to the difficulty of expectoration, the incompletely closed glottis rendering a proper expiratory blast impossible.

Dyspnœa is another of the symptoms which requires notice. When severe, it is due to obstructed glottis, usually the result of inflammatory and œdematous swelling of the parts round its entrance, and the inspiration is apt to be more interfered with than the expiration. In such cases, this may be to the extent of requiring immediate tracheotomy, but in ordinary examples of laryngeal phthisis, the dyspnœa is not specially marked.

The prognosis in phthisis, when true tubercular disease of the larynx has shewn itself, is rendered still more grave, and though the downward course of the malady seems to depend on the pulmonary lesion, rather than on the laryngeal complication, there is no doubt that the aggravation in the cough which the complication gives rise to, must make matters much worse. When to the more harassing cough is added difficulty in expectoration, difficulty in swallowing, or dyspnœa, the patient's condition becomes indeed pitiful, and rapid downward progress is entailed. On the other hand, however, the non-tubercular affections, as anæmia and catarrh, and even tubercular infiltration and ulceration, may last for months or years, without appearing to affect very injuriously the patient's general condition. Sooner or later, however, the pulmonary disease becomes more active, and the laryngeal readily shares in the aggravation.

Can true tubercular mischief in the larynx heal? This is again a question difficult to answer, because by the laryngoscope, a healed ulcer cannot be proved to have been a tubercular one. The balance of opinion tends to the view that it can, and recent observations by Krause, Hering, and others, seem to have substantiated this. As with pulmonary

tubercle, it would seem that this desired result may be looked for in cases where the lesion is but slight, where the patient can be placed under circumstances which will lead to improvement in the general health, and where judicious local treatment can be early employed.

The treatment of the laryngeal complication is naturally bound up with that of the pulmonary in all respects in which the value of keeping up the general health is concerned, and of the various elements which conduce to this, laryngologists have recognised the immense benefit which may accrue, however inexplicably, when the somewhat vague advice to seek change of air is followed. This need not be discussed at present, but there are certain local methods of affecting beneficially the disease, which must here be considered. Foremost amongst these is absolute rest to the larynx, and though open air and exercise should be enjoined for the general condition, the patient should be advised, for weeks or months if necessary, to speak as little as possible, and then only in a whisper.* The cough should be kept voluntarily in abeyance as much as possible, and if the larynx is so sensitive that going into the open air excites it, a respirator may be worn. It will often, however, be found that, with perseverance, this sensitiveness to temperature will diminish, but the greatest care as regards cold must always be taken ; and one often finds in phthisis that, to a distinct exposure, the supervention or aggravation of a laryngeal complication is attributed. Smoking, at any rate within doors, or sitting in a smoky atmosphere, is, for obvious reasons, also to be avoided. The climate most suitable for cases of phthisis with laryngeal complication, are the moist, warm ones. (See Climates, p. 256).

For the simple cases in which catarrh of the larynx alone exists, the use of astringents is recommended, especially of

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* The performance of tracheotomy has been advised (Bryant, 1868), to obtain complete rest of the larynx. See also Schmidt, Deutsche med. Wochenschr., Dec. 9, 1886.

nitrate of silver. This, in the strength of 20 grains to the ounce, applied with the laryngeal brush at first, every day, and after a week at longer intervals, will often be found useful. In addition, solutions of tannic acid may be used in the same way ; * and medicated sprays, or the insufflation of astringent powders, have also been tried, but are not so satisfactory. Where there is muscular paresis, the use of electricity is advised.

In all these simple affections, it is to be remembered that their removal is an object always to be striven for, inasmuch as, so long as they exist, the chance of true tubercular disease occurring there is greatly increased.

When tubercular disease has fairly set in, all local astringents are contra-indicated. For the infiltrations, scarification has been advocated ; but for this stage, and for the stage of ulceration, the germicide remedies are of most use. Among these, lactic acid, in 20 to 60 per cent. solution, applied with the laryngeal brush, is said to be specially useful.† Iodol, in powder insufflated, has been recommended,‡ or carbolic acid in 1 to 3 per cent. solution with glycerine, may be applied with the brush, or in 2 per cent. solution with water for spray inhalation.

In those cases where pain in swallowing is a prominent symptom, this carbolic treatment will also be found useful, as it seems to act, to some extent, as a sedative. Where it fails, recourse may be had to morphia insufflation. Of the following powder,

Iodoform or Boracic Acid,	.	.	8
Powdered Gum or Starch,	.	.	2
Morph. Muriat.,	.	.	.	.	·5

Gottstein recommends about 3 grs. for insufflation. Instead

* Of such, the following is an example :—
        Acid. Tannici.
        Acid. Carbolici, a a, grs. 30.
        Morphiæ Acet., grs. 2.
        Glycerini, ℥i.
      Sig. Use with the Brush.
† Krause, Deutsche med. Wochenschr., Dec. 9th, 1886.
‡ Lublinski, Deutsche med. Wochenschr., Dec. 23rd, 1886.

of this, cocaine may be employed, either by applying a 4 per cent. solution with the brush to the epiglottis and parts about the larynx, or by inhalation.

In cases where the difficulty of swallowing fluids is great, the method proposed by Wolfenden (*Lancet*, July 2nd, 1887) may be tried. " The patient lies on a couch, stomach down, and with the legs elevated, and sucks, by means of an india-rubber tube, fluid from a tumbler held in his hand. This method was demonstrated to Wolfenden by a patient, who had discovered it for himself." (Year-Book of Treatment for 1888, p. 307).

A new and promising plan of treatment, however, for laryngeal phthisis, is that proposed by Rosenberg,* viz. :— the injection of menthol into the larynx, by means of a syringe. From one to two grms. (15 to 30 min.), of a 20 per cent. solution of menthol in olive oil are used, at first once or twice daily, afterwards more frequently. Along with Dr M'Bride, I have witnessed very gratifying results follow this menthol treatment in the Royal Infirmary. The plan followed there, was to practise the menthol injection at intervals of two or three days, and combine with it the use of the same solution by inhalation. A Mackenzie's or Yeo's inhaler was employed, and 15 or 20 min. of the menthol solution were applied at a time, the object being, to make the patient breathe an atmosphere of menthol. Employed thus, the drug seems to act efficiently as an anaesthetic or antiseptic, and to benefit the pulmonary as well as the laryngeal lesion. Discomfort to the patient, as the result of the injection, is but slight, and as a rule, the treatment is well borne.

Lastly, it is to be remembered that, in laryngeal phthisis, the possible necessity for tracheotomy must always be looked forward to.

Acute miliary tuberculosis is a disease depending upon infection by resorption from some tubercular focus within the

* Berlin. klin. Wochenschrift, No. 26, 1887.

body. It is an appropriate subject for consideration in a work on pulmonary consumption, inasmuch as it occurs frequently as a complication of that disease, its onset depending directly on the pulmonary trouble, and on account of the distinct, though not well understood, relationship (see p. 111) between the tubercle nodule, which constitutes its main pathological condition, and the tubercle nodule of the chronic tubercular process. It is always to be remembered, however, that it is an affection which may occur in the absence of lung mischief, and that, even in cases where such is present, the *post-mortem* appearances may indicate the source of infection of the acute malady to have existed somewhere else than in the lungs.

The affection is mainly characterised by the appearance of grey translucent-looking nodules, scattered in varying proportions through the substance of the lung, liver, spleen, and kidney, and over the surfaces of the pleura, peritoneum, and pia mater of the base of the brain.

The extent and distribution of these nodules differ much in individual cases; in a general way, the following statements may be made on this subject.

(1) That while lungs and pleura, liver, spleen, kidney, peritoneum, and pia mater may be affected, it must be extremely rare to find them all affected together. Out of 300 phthisical *post-mortem* examinations (adults), I found none in which all these were involved, and only two in which lungs and pleura, liver, spleen, kidney, and peritoneum were together stated to be the seat of miliary tubercular nodules.

(2) That in all cases of acute miliary tuberculosis, the lungs are specially liable to be affected; that, as a rule, the extent of the miliary lesion in phthisis is in the inverse ratio to the amount of lung destruction ; and that in cases of chronic phthisis, where the destruction of tissue has been for long confined to one lung, the sounder lung is particularly apt to be specially involved.

(3) That when tubercular ulceration of the intestine com-

plicates a phthisis, the peritoneum is peculiarly apt to become the seat of the miliary deposit.

(4) That fatty, or more especially waxy, changes in the abdominal viscera, seem to render them less liable to become the seat of the miliary deposit.

(5) That the complication of pneumothorax seems also to have a limiting tendency as regards miliary tubercle.

Corresponding with the variations in the amount and distribution of this deposit, and also with the general statement that it is apt to be inversely proportionate to the extent of lung destruction, are great differences in the prominence and character of its symptoms. When, on the one hand, the complication has supervened on old standing consumption, its onset will hardly be recognised in the progressive aggravation of the pulmonary disease. When, on the other, the originating lesion in the lungs has been slight, the symptoms of the new malady may more or less completely mask those of the disease on which it has supervened. The symptoms are also modified to a very important extent by the distribution of the complication. When, from foci in the lungs, the miliary infiltration has spread through those organs, and thence to peritoneum, liver, spleen, &c., the symptoms are distinctly different from those which present themselves when the brain is involved (tubercular meningitis) ; and when, in addition, it is remembered that this meningeal complication may be the chief one, or may accompany morbid changes in the other organs, even greater diversity in the symptoms can be readily understood to exist.

Practically, acute miliary tuberculosis supervening on phthisis may be considered in three aspects.

I. As a final occurrence in old standing cases, where the miliary lesion is comparatively slight, and limited to the lungs.

II. As occurring in more recent cases, where, in addition to its being markedly present in the lungs, the liver, spleen, kidney, and peritoneum, are more or less involved.

III. As occurring usually also in somewhat recent cases, where, in addition to the lungs, the pia mater is the part specially involved (tubercular meningitis).

Concerning the first of these, very little need be said. With the cough, hectic, perspirations, and emaciation of the original disease, its recognition is hardly possible. Increase of the dyspnœa, without corresponding increase in the extent of the lung lesion, being detectable by physical signs, may serve as an indication. The complication, like a fever, in-tensifies the air hunger, and perhaps also the miliary deposit in the lung, by stimulating the peripheral termination of the vagi, renders the respiratory nerve mechanism more irritable.

The disease assumes a different aspect when it compli-cates a slight pulmonary affection, as in II. It may then commence with rigors and all the constitutional symptoms of fever, the pulse becomes exceedingly frequent, the skin hot, there are copious sweats, and the patient loses flesh rapidly. There is cough, either dry, or accompanied by a scanty clear or yellowish expectoration ; dyspnœa is present ; and physical examination shows (except where the original phthisical disease exists) only rhonchi and rales. In certain cir-cumstances, as, for example, where the existence of a phthisis is unknown, the condition may be taken for typhoid fever. Careful inquiry into the history of the case, and examina-tion of the lungs, should prevent this mistake. Other distin-guishing features are, the more rapid pulse, the more marked dyspnœa and symptoms of bronchial catarrh, the absence of diarrhœa (tubercular intestinal ulceration, however, impairing the value of this symptom), the absence of rash and of splenic enlargement. Another condition which may cause mistake, is acute asphyxiating bronchitis, as stated by Walshe. In such cases there is also a history of cough and spit, and of loss of weight having been noticed for some time, and the symptoms, —rapid breathing, rapid weak pulse, duskiness of the face, and

lividity of the nails,—are often the same. But in the tubercular affection, though the skin may feel moist and cool, the thermometer will probably reveal a higher temperature than is usual in the bronchitic, whilst more careful inquiry into the history and the presence or absence of percussion dulness, will assist in the distinction of the two conditions. Even in the most careful hands, however, I have seen some temporary difficulty in connection with the diagnosis of such cases.

The disease may last from three to five or six weeks ; but from what has been said as to its extent in relation to the original lung mischief, considerable diversity in its duration as in its symptomatology, must be anticipated.

When, as in III., the pia mater is the part specially involved in the miliary process, the result, *tubercular meningitis*, though obscure at first, is distinctly indicated later on. This complication is a very important one from many points of view, and merits rather more detailed consideration. As regards frequency, it occurred 22 times in 300 phthisical cases, or about 7 per cent. It is more common in the early than in the late years of adult life, although instances of its occurrence in old age are reported. In the young it is much more frequent. I am unable, however, to state the proportionate numbers of phthisical children who die of tubercular meningitis, because *post-mortem* records indicate in them so frequently the existence of other possible foci for tubercular infection. Tubercular bronchial glands, tubercular pleurisy, intestinal ulcers, &c., so frequently occur, that though pulmonary disease may co-exist distinctly enough, it is impossible to state this last as the source from which resorption of the tubercular material, which has caused the complication, has occurred. Hospital statistics show it to occur much more frequently in males ; in connection with which it is of interest to remember, that phthisis is rather more frequent in females, and that hydrocephalus and nervous diseases generally are more frequent in the male sex. It

most commonly occurs in patients in whom the amount of lung disease is not very great.

The symptoms of tubercular meningitis often manifest themselves insidiously. The headache and vomiting, symptomatic of cerebral disorder, may readily be referred to medicine, or to the gastro-intestinal irritation and cough, whilst the pulse, temperature, respirations, and general condition show at first no very definite change. In time, however, the disease proclaims itself. The headache and vomiting become aggravated and more persistent, associated with which one or other of the following symptoms are to be looked for—photophobia, disorder of vision, confusion of ideas, muscular twitching, drowsiness, squinting, sluggish action of pupils, optic neuritis. The presence of an excess of phosphates in the urine is said, by Douglas Powell, to be a possibly important aid to the diagnosis in the early stage, and it is interesting to observe that, as stated by Walshe, the complication may be associated with improvement in the pulmonary symptoms. Later on, irregularity of the pulse and respiration may show itself, and the patient dies comatose.

The prognosis in acute miliary tuberculosis is practically hopeless, but examples of recovery, in both its pulmonary and meningeal manifestations, have been reported. Remembering that the grey nodule of the chronic process may undergo fibroid change, it is theoretically reasonable to suppose that, from the acute in the early stage, recovery may possibly occur.

With regard to treatment, very little need be said. When, in an old standing or more recent case of phthisis, we suspect the onset of this complication in the lungs and pleura, then in addition to feeding, and large hot fomentations to the chest, digitalis, iron, and iodide of potassium will probably suit best. When the meninges are the seat of the deposit, cold in the form of the ice bag to the head, the iodide and bromide of potassium, and laxatives, are the main indications.

CHAPTER IX.

LOCAL AND CONSTITUTIONAL TREATMENT
OF PHTHISIS.

IN discussing the individual symptoms and complications of phthisis, the various appropriate plans of treatment have been enumerated and described. There remain, however, for consideration other methods by the use of which benefit may be obtained. In proceeding to the consideration of these we are at once reminded of the saying,—the truth of which phthisis is looked upon as being so strikingly an example,—that the number of remedies proposed for a malady is always in the inverse ratio to our power of removing it. Any tendency, however, on this ground to regard treatment as of but little value, and consequently to employ it, if at all, in a half-hearted manner, would be injurious in the extreme. The course of phthisis is certainly apt to be progressively unfortunate, and our study of the physical conditions of the lungs has shown us how it should be so. Yet the disease manifests very great differences in different cases as regards duration and variety and prominence of symptoms. It presents also every now and again periods of amelioration or of arrest, and these, too, at times when, everything seeming hopeless, uniform downward progress has been confidently anticipated. True, these occurrences are exceptional, and they are often but temporary in duration, still they do occur. But what is of special importance is, that the causes of such fortunate changes in the course of events are often so slight as to escape recognition. To a change of air or surroundings, to an article of

diet, to rest in bed, to a new plan of treatment, &c., these are constantly being ascribed with more or less correctness; but in many cases they seem to come on, as it were, of themselves, and the conclusion forced upon us is, that they are representative of periods in the struggle between the salutary and injurious effects of nature when the former have gained the mastery. Given a case of tubercular deposit in a lung apex —in which the inflammatory process round about has been sufficient to cause encapsulation and softening, but not to cause impaired nutrition of the surrounding tissue nor weakened general nutrition by fever, in which the respiratory movements and cough have been sufficient to loosen and eject the softened caseous mass without carrying parts of it as infecting foci to other portions of lung, without distending the cavity so formed, or without tearing through comparatively healthy lung tissue, and in which fibrotic contraction has been sufficient to produce cicatrisation without causing injurious traction on surrounding air cells or bronchial tubes—in such circumstances an arrest will occur. To produce an arrest, therefore, there must be a favourable combination of a great number of events, and consequently treatment can only be efficient if it is always so acting on each of these that when a fortunate moment arrives nothing unfavourable is existing to mar the process.

The great number of remedies and of remedial measures advocated for consumption, therefore, whilst it may demonstrate, as has just been stated, our comparative impotence over it as a disease, must also be looked upon as denoting that a remedy, or a remedial measure which may often appear trivial or even useless, may at times be so important as to make all the difference between an arrest and continued downward progress.

Opportunities of influencing favourably the disease must therefore be watched for and taken advantage of, and the unfortunate inefficiency of remedies is to be regarded rather as indicating the necessity for more careful endeavours to

interpret scientifically its phenomena than as signifying, as is too much the rule, practically the uselessness of all treatment. Further excuse for discussing in detail other plans of treatment is therefore uncalled for.

These may be divided, in the first place, into local and general. The local comprise all the methods of affecting beneficially the disease by acting on the pathological processes in the respiratory organs directly ; the general, all the methods of obtaining the same results by acting on the general nutrition of the individual. Under the former come for consideration the various methods of increasing or diminishing the functional activity of the lungs, the subject of aerotherapeutics, antiseptic applications, pneumono-surgery, &c. Under the latter come the questions of hygiene, occupations, climate, &c.

The general value of treatment directed towards increasing or diminishing the functional activity of the respiratory organs can very easily be understood. Phthisis is, as has already been stated, essentially the result of disuse of the pulmonary apparatus, and as essentially it occurs primarily in those parts of them, the apices, where the disuse pertains to the greatest extent. Hence we ought to expect that whatever favours lung function generally and apex function specially should be beneficial. But to this question there is another aspect, for, given as the result of disease, a lung at a point in which is a blood vessel with its wall nearly perforated by tubercular deposit, or a separating softened caseating mass in close proximity to a thinned and weakened pleura, then increase of lung function might, by causing rupture of vessel wall or pleural membrane, be the determining cause of progressive misfortune in a case which, with rest, might have made as direct progress towards a favourable issue. In this way can be explained the great difference of opinion expressed by physicians as to the value of the various plans of treatment directed to increase or diminish respiratory activity ; some advocating such pursuits as singing, gymnastics, rowing, horseback or cycle

exercise ; and others expressing themselves equally strongly upon the value of rest, chest strapping, lung splints, &c. To decide upon which plan to follow in any case is always a difficult matter, and a conclusion can only be arrived at after having taken into consideration all the existing or possibly existing physical conditions in the diseased lung. These have been already described (see Chap. III.), so that in discussing the various means of influencing respiratory activity in detail, little in the way of reference to them need be made.

It may be taken as a general rule in phthisis, that the longer a patient can be kept on his legs the better, and again and again it will be observed, that when once confinement to bed has taken place, increase in the rapidity of the downward course follows. Doubtless this effect may be more apparent than real, inasmuch as with the advance of the disease the symptoms become progressively more severe, so that when rapidly progressive weakness necessitates complete rest in bed, rapidly progressive aggravation in the symptoms must, quite independently of this, be expected. This, however, does not affect the value of the general rule, to let the patient keep moving about as long as possible. To it, however, certain qualifications must be added.

In the first place, when, as often occurs with hospital cases, a phthisical patient, previous to admission, has been wandering about ill fed, ill cared for, and exposed to weather vicissitudes, a week or two of rest in bed and feeding will often be sufficient to cause an arrest. Secondly, where the physical changes in the lungs are such as to lead us to assume the existence of aneurisms, or of vessels with walls more or less weakened, and when the symptoms indicate the risk of hæmorrhage, rest in bed may be required. In old standing cases of fibroid phthisis, in which such vascular conditions are occasioning repeated and profuse hæmorrhages, and in which these hæmorrhages are preceded by symptoms, vague in character, but sufficient to act as a sort of premonitory

indication of such mischief to the patient himself, rest is, of course, desirable, and one frequently sees cases of this kind in which there is reason to suppose that this precaution, coupled with the administration of a purge, lessens the frequency and severity of the bleedings. Thirdly, where, in a chronic or sub-acute case, sudden increase of fever and chest pain indicate the supervention of inflammatory processes in lung or pleura, rest in bed may be demanded. When the ordinary mixed inflammatory and resorption fever is acute, it is often a difficult matter to decide as to whether rest in bed or moving about is the safer advice to give. In such circumstances the patient's inclinations are of great value, and a trial for a few days of one or the other plan may be made.

Suppose that in a case of phthisis with evidence of cicatrisation we are led to anticipate no risk of injury from weakened vessels or lung tissues, so that stretching of the fibroid new growth, with the production of local emphysema, seems most desirable, what plans are there by which the required increase in the functional activity of the lungs can be brought about?

Making the patient walk up and down stairs daily, which in pleurisy is often useful for promoting absorption of fluid and lung expansion, is not so applicable in phthisis, as in this latter disease the combination of fresh air and sunlight, with exercise, is far more imperatively demanded. In certain circumstances, however, and as an adjunct to other treatment, it may be tried.

Singing is viewed differently by different observers. Pollock discusses it and the playing of wind instruments in connection with the treatment of the premonitory stages, and states that, although somewhat favourable results were occasionally obtained, it seemed often productive of hæmoptysis. Jaccoud is entirely opposed to it, on the ground that its practice, by necessitating prolonged expiratory and short and superficial inspiratory acts, does not induce proper distribution of air throughout the lungs. He also notes its tendency to induce

hæmorrhage. But if in developed cases of the disease some hesitation may exist as to recommending this practice of singing, there can be no doubt that, in the absence of distinct pulmonary lesion, and in cases where complete cicatrisation has occurred, it must, by provoking alveolar inflation, act antagonistically to phthisis. Ruehle states that in his obsertion trained singers rarely become consumptive.

In feeble individuals, when circumstances warrant its use, a simpler means of distending the air cells may be employed. This is, by making them, at stated intervals, perform several deep inspiratory and expiratory movements, in as pure an atmosphere as possible. Reading aloud has also been tried.

Aerotherapeutics, obtained by mechanical contrivances designed to secure the respiration by the patient of an air denser or rarer than the atmospheric, has been again and again recommended. Jaccoud expresses himself strongly in favour of it, and in Germany, its employment seems to have met with some success. There is no doubt, however, that its value will be greater in pleuritic effusion than in consumption, since, in the latter disease, something else than simple distension of air cells is more emphatically required. In this direction, any exercises demanding muscular effort on the part of the arms and chest of the individual are much more likely to be useful. Dumb bells and club exercises come into this category, but of all, those which can be taken in the open air are certainly the best. In appropriate cases, in addition to walking or climbing, and horse riding, so much lauded by Sydenham, exercises which directly affect the thorax, as rowing, skipping backwards, and tennis, will often be found of the greatest value.

In other circumstances, rest to the affected lung is the object to be desired, and when with this a certain amount of compression is associated, the good effects are likely to be increased. The pathological conditions which call for this plan are existent when softened caseous material has been

more or less completely removed. Fibroid encapsulation or
cicatrisation is then desired, but to determine clinically when
the means for securing rest or compression should be applied,
is in many instances well nigh impossible. In cases of doubt,
however, a day or two's trial can do no harm, and the
patient's symptoms and inclinations will afford an indication
as to its appropriateness. For such purposes, strapping of the
affected side and the wearing of the arm in a sling have both
been tried, and a so called lung splint has been proposed by
Dobell. This " consists of two padded metal plates adjusted
to the anterior and posterior surfaces of the thorax at the
affected pulmonary region, and held together by a thin steel
band, the force of which can be easily increased or diminished
at will." Although the benefits of treatment of this nature
are obviously not so likely to be as patent as those which
have for their object the increase of lung function, yet, in
many cases both of apical and basal mischief, much good can
be done, and it is to be remembered that a combination of the
two may be tried. In a case, for example, where symptoms
and physical signs indicate softening and possibility of the
onset or restarting of hæmorrhage, the risks entailed in per-
mitting the patient to move about may be more comfortably
faced, if the movements of the affected part be restrained by
a bandage or strapping. As has been already mentioned, too,
the intercurrent pleurisies of phthisis may be similarly dealt
with.

With a view to produce complete rest of lung, the produc-
tion of pneumothorax artificially has been proposed, and when
the great probability that cases of slight apex affection may
pass through this complication to recovery is contemplated,
it certainly might seem worthy of trial, especially when we
remember that, if artificially induced, an aseptic air would be
admitted into the pleura. On the other hand, it is to be argued
that such slight cases of phthisis can readily heal without
the necessity for such heroic treatment, and that, when the

mischief is more advanced, the pleuritic adhesions in the neighbourhood of the affected part which are almost certain to exist, would interfere with the occurrence of the collapse at the very region where it is most required.

Of much more practical importance is the treatment of lung cavities, the result of phthisis, bronchiectasis, abscess or gangrene, by incision, washing out, and drainage, or the injection into cavities and phthisical foci of antiseptic and other solutions. These modes have long been advocated, but it is only comparatively recently that they have been undertaken and practised with success. For treatment by incision and drainage, basal cavities are most fitted. In them the difficulty of healing is probably the result of hindrance to the emptying of their contents, hence they are much more frequently single and large. They are, after being efficiently drained, most likely to undergo diminution in size, and they present an additional advantage in that the chest parietes below, viz., the diaphragm and lower ribs, are comparatively yielding. Further, resection of portions of ribs being a less serious operation at the lower than at the upper part of the chest, the subsequent contraction of the cavity can be still further aided. Cases of apex cavities treated in this way are not wanting, although the results, as we shall see, are not so favourable.

A phthisical patient for the treatment of whom incision and drainage is most appropriate, presents, in addition to the symptoms of the disease, a very abundant mucopurulent sputum, which is occasionally sanguineous and frequently fetid. This may be got rid of by a frequent harassing cough, but usually there occurs at somewhat long intervals the bringing up of very large quantities of expectoration. In the most favourable cases, absence of bacilli and lung tissue in this is noted. On examination of the chest, very marked dulness over a lower lobe will be detected by percussion, or if the cavity be near the surface, a tympanitic note, altering in

pitch with the opening and closing of the patient's mouth and nostrils, may be elicited. On auscultation, cavernous breathing, with amphoric resonance of voice and cough, whispering pectriloquy, and consonating râles will probably be heard. Those auscultatory signs, however, are not to be expected, if the cavity contains much secretion, and it is often best to take the opportunity of examining such patients as soon as possible after a profuse expectoration.

The diagnosis will be made complete by the introduction of a trocar and the aspiration of the contents, and the point usually selected for puncture is posteriorly in the region of the lower angle of the scapula, *i.e.* the eighth, ninth, or tenth interspace, about three inches outward from the spine. In most cases of this kind reported, the percussion and auscultation signs of cavity have been there most marked. Should, however, these be manifested better at another part of the chest wall, there is no reason against puncturing there, provided the risk of injury to diaphragm, liver, heart, and large vessels at the root of the lung be excluded.

A satisfactory diagnosis of the existence and locality of a large cavity having been arrived at by puncture, the operation of free incision and drainage may be undertaken at once, or delayed for a few days. The advantage of operating at once is, that the preliminary steps of the operation are already completed; the advantage of delay is, that having freely evacuated the contents of the cavity, its size, relations to other viscera, and the condition of other parts of the lungs, may be more easily made out by a physical examination, whilst important information as to the patient's general condition and suitableness for operation may be obtained, by noting the behaviour of the temperature, pulse rate, &c. after the tapping.

The operation itself may now be described. If it is considered desirable to operate immediately after the tapping, the patient should be made to lie on the affected side in order

to avoid gravitation of the secretion into the healthy lung.
He should be anæsthetised gradually, in order to prevent
coughing as much as possible, and not very profoundly, in
order that if fluid should get into the bronchi of the sound
lung, its riddance by coughing may yet be brought about.
Care being taken to keep the trocar in position and out of
harm's way, an incision three or four inches in length is then
made, parallel to the intercostal space which the canula trans-
fixes, and including the canular opening in the middle of its
course. The intercostal space is then freely exposed, and all
bleeding stopped. The next step in the operation will pro-
bably be to remove a portion of rib (about an inch) at a spot
corresponding with the position of the canula, the reasons for
this being, that in such cases there is a tendency to approxi-
mation of ribs, and that space is an essential requirement.
An incision is next made through the pleura at the point of
entrance of the canula, just large enough to admit the slender
probe-pointed forceps of Lister, which, guided by the canula,
is pushed slowly inwards till the cavity is reached, then opened
out and as slowly withdrawn. The finger can then be intro-
duced, and with it, and with a long flexible probe, the size and
shape of the cavity can easily be ascertained, whilst through
the enlarged opening any secretion which it contains can be
removed. A large drainage tube is then inserted, kept in
position by being attached to a piece of strapping, and the
wound is dressed with salicylic wool.

In a case where, after tapping a cavity and drawing off a
quantity of fluid, it is considered advisable to delay operating
for a day or two, the mode of procedure is, after anæsthetising,
to make an incision like the one already described, the centre
corresponding to the point where, on previous examination,
auscultation has indicated the cavity to be most superficial.
The intercostal space is then exposed, all bleeding arrested,
and a canula pushed into the cavity. The subsequent pro-
ceedings are, as already described, resection of a portion of

rib, incision of the pleura, and introduction and withdrawal of the probe-pointed forceps, &c.

In discussing this operation, Douglas Powell points out that the puncture of the cavity after exposure of the intercostal space has the advantage, in that its depth from the surface can be more easily gauged, and that, should none of the contents show themselves escaping through the canula, the operator can, by gentle lateral movement, ascertain whether its point is free in a cavity or not. The advantage of opening into and draining such a cavity at a spot where physical signs indicate it to be nearest the chest wall is obvious, when we remember that the patient, after the operation, lies upon his back.

Difficulty sometimes occurs in finding the cavity with the exploratory trocar; on pushing it into the lung, neither secretion nor whiff of air show themselves passing through it. In such circumstances it must be withdrawn, and pushed in as carefully again at some other part. An aspirator which can readily be connected with the canula may be found of service in these efforts to strike the cavity. In a case mentioned by Powell, although the exploring canula reached the cavity easily enough, it was not found by the instrument required to enlarge the opening. A drainage tube was then left in, and as was to be expected, the cavity ultimately opened into and discharged through it. The depth at which such cavities lie from the surface seems to be from about three to five inches.

The pleuræ in such cases are almost always adherent. Should the incision through the parietes show that this is not so, it is recommended to suture the lung to the chest wall at the point, and delay further proceedings for two or three days. A risk associated with non-adherent pleura is its infection by septic products from the lung. This, however, applies to operations undertaken for gangrene or abscess, rather than for chronic basal excavation.

Hæmorrhage may also be a cause of difficulty. It is fre-

quent, often profuse, but seldom dangerous. After free opening up of the canal leading to the cavity, and free escape of its contents, it usually stops. It may, however, require plugging. Godlee recommends the thorough mopping out of the wound with a one in forty solution of chloride of zinc, which tends to arrest bleeding, besides being valuable from an antiseptic point of view. It is to be remembered further in this connection, that any respiratory embarrassment on the part of the patient will favour hæmorrhage, and that, as the large vessels radiate to and from the root of the lung, we should endeavour in operating to keep as far from this locality as possible. With a view of diminishing the risk of hæmorrhage the thermo-cautery has been employed to penetrate the lung ; cough, however, seems then to occur so severely as to threaten suffocation.

Hæmoptysis is almost certain to occur during or after the operation, but seems to be of no importance.

The results of such operations for basal disease of the lung are, as already stated, most favourable when the cavity is large and single. If there are several cavities, so much good cannot obviously be expected ; still, as they usually open freely into one another, drainage can be obtained, and most gratifying results may follow. It would seem also that by the free openings through the lung tissue, and by the resection of a portion of one or more ribs, which the operative interference requires or permits readily to be done, fibroid growth and cicatrisation are favoured. Further, there is no doubt that, as Douglas Powell has pointed out, much of the expectoration in such cases is due to the retained secretions irritating the bronchial mucous membrane, and hence by the operation cough and expectoration are lessened. Where interference is followed by a fatal issue, pleuro-pneumonia of the sound portions of lung from inhaled secretion, abscess of the brain, and meningitis, form the usual *post mortem* appearances.

The treatment of apex cavities by incision and drainage is

by almost all observers regarded as inadmissible, a conclusion which can readily be understood when it is remembered that in them retention of secretion, if it obtains at all, is not likely to be the hindrance to contraction and cicatrisation. Further, apex cavities are usually multiple, and have interspersed among them softened and caseating· foci, conditions to which such an operation can hardly be expected to afford much benefit. Instances, however, of cases in which such treatment has been adopted with results favourable to some extent are not wanting, the best known, perhaps, being those reported by Mosler.*

While apex phthisis is to be looked upon as unlikely to be much benefited by incision and drainage as such, there is a possibility that the resection of a portion of rib which the operation entails might be of use. When we remember that in chronic cases apex excavation is to be regarded as being to a large extent due to the unyielding chest parietes ; and when we remember how the cicatrising processes are often so active as to drag in the chest wall above and below the clavicle, and to drag over the heart and sound lung, we cannot but feel sure that, were this retraction favoured by operation, cicatrisation might much more readily occur.

[The literature of lung surgery is far too voluminous to be detailed. Particulars will be found in Douglas Powell's "Diseases of the Chest," 3rd edition, page 205 ; and full accounts of it are given in the following :—Koch, Berliner klinische Wochenschrift, 1876 ; Truc, "Essai sur la chirurgie du Poumon " (Paris), reviewed in the "Year Book of Treatment for 1885 " ; De Cerenville, " De l'intervention operatoire dans les maladies du Poumon," reviewed in the "Centralblatt für klinische Medicine, 1886 " ; and Godlee, *Lancet*, 1887.]

The injection into the lung of germicide substances was a treatment proposed for phthisical disease before the works of Koch were given to the world ; but since then, as the natural

* Ber. klin. Wochenschr., 1873.

result of the greater attention given to the association of the tubercle bacillus with the diseased processes, this mode of treatment has become more prominent. Its object is, of course, to destroy the bacilli by enabling the germicide to act upon them in a manner more thorough than can be obtained by inhalation or internal administration.

The substances used for this purpose have been various. Liq. iodi in 10 minim doses (Beverley Robinson) ; Liq. iodini co in the strength of 1 to 15 and afterwards of 1 to 5, in doses from 4 to 25 minims (Pepper) ; iodoform, grs. ii. to m. x of ether (Shingleton Smith) ; carbolic acid in 2 or 3 per cent. solution, and 20 to 30 m. injected (Pepper, specially if fœtor present) ; bichloride of mercury in strength varying from $\frac{1}{2000}$ to $\frac{1}{500}$ gr. (Gouguetheim, the temperature of the fluid to be raised to that of the body before injecting) ; creosote dissolved in alcohol, 2 to 4 per cent. (Truc) ; sulphocarbolate of soda, 15 per cent. solution, ʒ i. to be injected (Williams).

The mode of operating followed by Pepper * is as follows :— The solution to be injected is held in a syringe capable of containing 28 minims, and with which is connected a small steel canula three inches long (Williams uses a canula with side openings, so that the fluid may be projected laterally). The patient is placed in a sitting posture, and the skin over the interspace through which the injection is to be made is frozen or anæsthetised by 20 per cent. solution of cocaine. The needle is introduced from one and a half to two and a half inches, the patient being ordered to take a long breath, and to hold it during the time of injecting, which, as the fluid should be driven in slowly, should last, according to Pepper, about thirty seconds. The quantity of the solution used varies from 4 to 25 minims, the injections are into one, two, or three interspaces, and the operation is performed once a week. The precise region of the chest into which the injection is made will vary with the locality of the disease ; but

* " New York Medical Record," vol. xxvii., p. 31.

the axillary region, and anteriorly outside the nipple, have been specially selected for this purpose.

According to all accounts, no injurious effects follow this treatment. Cough is seldom excited, and hæmoptysis has never been dangerous. The existence of adhesions seems to prevent any harm taking place in connection with the pleura. In one instance, the injection was followed by subcutaneous emphysema over the pectoral muscles and front of the neck; this, however, shortly disappeared. The most favourable results have been obtained when the disease is not extensive, and where there are cavities, in which circumstances this treatment has diminished cough expectoration and fever, when all other measures have failed to do so. In cases of extensive disease, it seems to have been useless.

Another mode of affording to germicide remedies more direct access to the diseased tissue than can be obtained by inhalation or administration by the mouth, is intratracheal injection. This is described in the chapter on Laryngeal Phthisis, see p. 227; here it need only be stated that my experience of this plan in pulmonary phthisis has been undoubtedly favourable.

On the strength of some experiments of Claude Bernard, which showed that a substance like sulphuretted hydrogen, poisonous when inhaled or injected hypodermically, may yet be absorbed from the intestine in large quantities by the portal system, carried to the lungs, and there excreted without producing injurious effects, Bergeon has proposed and carried out a treatment which has of late received a good deal of attention. He slowly injects by means of an apparatus a mixture of carbonic acid and sulphuretted hydrogen gas into the rectum, in a quantity of about four litres at a time. As a result, considerable abdominal distension is induced, but this gradually disappears, and the gas is slowly eliminated through the lungs, as evidenced, according to Bergeon, by the odour of sulphuretted hydrogen being discoverable in the

patient's breath.   Bergeon holds that there is obtained in this way on the lung disease a germicide effect, and states that in practice, in hundreds of cases, he has met with correspondingly favourable results.   Other physicians have not been so fortunate with this treatment, and Williams states that in his cases no evidence of sulphuretted hydrogen in the expired air could be detected.

CHAPTER X.

HYGIENIC, DIETETIC, AND CLIMATIC TREATMENT OF PHTHISIS.

PHTHISIS, we regard, as being mainly the result of that struggle for existence which renders functional activity of the lungs less necessary, and the air breathed less pure, and likely to contain particles, organic or inorganic, more or less injurious to health. This main cause manifesting itself ordinarily, in a too sedentary life and bad air, may originate the disease in an individual sound as regards family and personal history, or it may do this, and then much more readily, in the case of one who has acquired a vitiated constitution as the result of some acute or chronic disease, or whose progenitors have transmitted to him a constitution vitiated as the result of the influence of similar injurious surroundings in them. As has been stated, phthisis represents one of the sacrifices which nature demands for a progressive civilisation, hence, like other diseases of the individual organism, and like poverty and crime in the social organism, no royal road to its elimination can be expected. Its progressive amelioration may confidently be predicted, but this will only occur *pari passu* with the gradual enlightenment of individual and public opinion, and with a correspondingly gradual rise in the scale of social and individual well-being and comfort. The fact that it is a disease which affects all classes is in no sense contradictory to this, for the luxury of the rich and the privations of the poor alike lead to it. It is to be remembered also that it is mainly among the well-to-do, *i.e.* among those who can be relieved from the pressure of the

existence struggle, that proper treatment can be obtained. The fact, further, that the savage or semi-civilised tribes of America, Africa, and Asia are practically free from it, and that whenever they mingle with the white men they seem to be specially liable to it, is corroborative of our theory, and from the broad sociological point of view is of good omen, for it demonstrates on the part of humanity in general a capability of becoming adapted to the apparently less healthy environments of an advanced civilisation, and on the part of the white man in particular some progress towards this end.

This consideration is further of great practical value, because it tells us in a general, but none the less important way, that the treatment for consumption in an individual is to place him, as it were, some distance back in civilisation, to remove him from the busy haunts of men to a region where the greater part of the twenty-four hours can be passed in the open air and sunlight, and in the performance of such an amount of physical work as is suitable to his condition.

To pass from generalities to particulars, the hygiene and dietetics appropriate to the various periods of life should be considered. This in a work of this kind would, however, be out of place; attention need only be directed to whatever is of most practical importance in connection with the liability to phthisical disease.

In infancy and childhood, fresh air and sunlight are of the highest importance, and although it is always to be remembered that warmth is an essential in the early periods of life, under few pretexts should the daily outing (in the nurse's arms, not in the perambulator) be omitted. The ventilation of the day and sleeping room should be looked after, rooms so placed that the sun can stream into them should be selected for such, and the risk of cold which ventilation may entail should be avoided by open fires, plenty of warm clothing, and the placing of the child's cot out of the line of draughts.

The risk of catching cold will be warded off by the morning

immersion in coldish water, the value of which in keeping the heat-regulating mechanism in proper working order has been explained by physiology.

["By the systematic application of stimuli, *e.g.* cold baths and washing with cold water, the muscles of the skin and its blood vessels may be caused to contract, and become so vigorous and excitable that when cold is suddenly applied to the body or to a part of it the excretion of heat is energetically prevented, so that cold baths and washing with cold water are to a certain extent gymnastics of the cutaneous muscles, which under the above circumstances protect the body from cold." Landois and Stirling's Physiology, page 470.]

The infant should be brought up on the breast, a healthy wet nurse being safer than the bottle if the mother is not available, and the period of lactation should be prolonged rather than otherwise, the appearance of the teeth being the signal for the addition of some more solid food—gruel, rusk, porridge, bread or potatoes and gravy, &c. The greatest care should be exercised in connection with all the details of vaccination; and the risk of exposure to any of the epidemic diseases, hooping-cough, measles, or scarlatina, sedulously avoided, the pulmonary affections and glandular enlargements so often occurring as their sequelæ, being specially dangerous to those in whom a liability to phthisis exists. Should, from any cause not exactly ascertainable, the child appear debilitated or anæmic, iron in the form of the citrate of iron and quinine should be given in small doses. Cod oil may also be used in the latter parts of the first year of life.

Later on, in childhood, boyhood, and girlhood, the same attention should be given at home and at school to fresh air, sunlight, and ventilation; the daily bath in the house, or in the sea during the warm weather, should be enjoined, care being taken that the drying process after it is thoroughly well performed. All kinds of out-door games are of use, those which entail the exercise of the muscles of the arms and chest being

specially so.   The enlarged cervical glands, which frequently
suppurate about this and the next period of life, are to be
looked upon as dangerous, in affording foci from which
tubercle bacilli may be absorbed.   Their extirpation has
accordingly been proposed as a preventive, but probably few
will put this practice into operation.   The comparative infre-
quency of enlarged strumous glands with active pulmonary
disease has been already alluded to (p. 52), and it has been
shewn that the lung mischief is more likely to occur later,
when the glands have diminished in size.

With puberty, adolescence, and early adult life, in the case
of those who are predisposed to phthisis, come additional
reasons for concern and care.   It is then that the nutritive
and functional changes connected with the completion of
growth have to be passed through ; anabolism has to occur
with proportionately increased activity, as evidenced by the
more rapid increase in the height of the body, and propor-
tionate augmentation of katabolism, as manifested by the in-
crease in the respiratory capacity, has also to take place, those
two processes being so affected towards one another, that
although the stage of balanced metabolism of adult life is
entered upon, and although they are both relatively less
active than in earlier years, the former (anabolism) undergoes
the greater relative diminution in activity.   All this, which
we must look upon as denoting on the part of the organism
diminished resisting power to disease, has been considered in
Chapter I. ; and we can readily understand how the general
mortality and phthisis mortality should show an increase at
those years.   Next it is to be remembered that, at or about
the periods of life which we are discussing, there is a greater
liability to such diseases as pleurisy, pneumonia, and typhoid
fever, all of which are apt to lead to that weakened state of
the general nutrition which predisposes to phthisis.   In this
light syphilis is also to be mentioned, its connection with the
etiology of lung disease being often as direct as in such cases

is its treatment satisfactory. Finally, the occupation has to be decided upon, and although some employments are, as has been seen, comparatively healthy, the selection means, in the great majority of cases, a change on the part of the individual to circumstances less favourable to health. That between the ages of fifteen and twenty-five, therefore, phthisis should become much more prevalent need not be surprising.

At these times, then, open air and exercise are more than ever desirable. Exercise should, of course, not be too violent, but often something more than is entailed by walking is required. It is true that to some violent exertion the initial bleeding of a phthisis is often ascribed ; but the real mischief has pre-existed in the vast majority of such cases, and the exertion has only brought about what some slighter cause would have unfailingly occasioned later on. Out of doors, therefore, riding, rowing, tennis, and cycling, and indoors, gymnastics, sparring, dumb bells, and clubs, have each their value when used in moderation. For girls, outdoor exercises, as riding, tennis, tricycling, are also to be recommended, not only for their own sake, but as tending to lead to the wearing of less objectionable clothing. The ordinary evening dress, with low neck and short sleeves, is obviously injurious. At these periods of life, too, what may appear to be but trifling deviations from the general health should cause concern. Slight dyspeptic symptoms, gastric or abdominal pain, anæmia, breathlessness, and a mobile pulse rate, being specially frequent in the prephthisical stage, ought all to be carefully inquired into and their causes removed ; constipation is to be treated by diet and regimen rather than by drugs. Should such maladies as typhoid fever, pleurisy, and pneumonia supervene, no sacrifice should be considered too great to ensure complete return to health before the ordinary daily work of life is recommenced. The question of occupation is one which depends mainly on the pecuniary circumstances and influence of the individual or his parents, and falls, therefore,

rarely to the physician for decision, still his advice may be valuable.   In a general way he knows that the best occupations are those which are neither too sedentary nor too straining, and that a slight excess of the latter appears to be the less dangerous as far as phthisis is concerned.   He can also take into consideration the individual conditions in a family.   In the case of those most resembling the parent from whom the predisposition is inherited, of those who are of tall and slender physique, or of those who have suffered in earlier years from pleurisy, pneumonia, typhoid, or rheumatic symptoms, he will be the more particular in advising an occupation which will entail some amount of outdoor work in the country or in a country town.   Though the curve of phthisis shows its maximum mortality about the twenty-fifth and thirtieth years, it is to be remembered that it is very prevalent long after that time, hence the importance of obtaining for those predisposed to it a life's work under as favourable circumstances as possible.

When pulmonary consumption has distinctly shown itself, its hygienic, dietetic, and climatic treatment must vary according to its cause and type, and according to the individual conditions of the patient ; and inasmuch as these differ in an extreme degree from one another in different cases, the indications for treatment can be considered only in the most general way.   A possible cause for the onset of the malady should always be sought for, and the more distinctly it can be traced to a dusty atmosphere, a too sedentary occupation, previous disease, privation and exposure, the more distinctly favourable will be the result of proper treatment.   When the phthisis is due mainly to the last of these causes, privation and exposure, hospital treatment is specially valuable.   Every hospital physician has seen instances of the rapid improvement which takes place when homeless waifs, suffering from phthisis, obtain the benefit of indoor treatment.

In the great majority of cases, what must be regarded as of the greatest importance in treatment, however, is change of

air and scene, and the consideration of the questions as to where the patient should go, and when he should be sent away, is often a difficult one.

' In recent cases with some amount of fever, with comparatively little in the way of physical signs detectible in the lung, and with little or no hæmoptysis, removal from the place where the disease has shewn itself, should be at once insisted on. The patient, in these circumstances, need not be sent far away, at least to begin with ; during the summer and autumn, a residence on the coast of England or Scotland, or in the interior hilly districts of Scotland, will do ; in the winter and spring, the South of England, or if it can be afforded, a trip to the Mediterranean will be best. The main object here is to procure an arrest of the lung disease, removal by ex-pectoration of the softened products, and cicatrisation, and for this, air and sunlight are absolutely essential. In all cases, there is the risk of cold increasing the bronchial, or setting up laryngeal or intestinal catarrh, yet a change of residence is always the proper course. The worse the patient's symptoms, the less should be the distance to which he is sent ; but a change, if at all possible, should be obtained, for even in circumstances apparently most unfavourable arrests may be obtained. I have seen clear examples of such during the worst months of the year from a change from Edinburgh to a few miles out in the country, from a sojourn for a few weeks in a stormy part of the Shetland Islands, and from a fortnight's trip in a small steamer trading between Leith and the English Channel ports. Of course, for this change, the more favourable as regards pure air and sunshine the locality is the better, and in choosing the locality the patient's inclination should be consulted, *e.g.*, as to preferring inland to the sea, the east to the west coast, &c. In all cases, however, the change is the important point, the bye considera-tion being so to place him that should, after a few weeks or months, the disease present the same progressive course, he

can either readily be brought home, or can be sure of obtaining where he is home comforts and proper medical treatment.

In chronic cases in which the lung mischief is slight and in which there is no fever, or in cases like those above alluded to in which an arrest has been obtained, a long voyage or prolonged residence abroad is to be recommended. Unfortunately this plan can but seldom be carried out, but each individual case must be studied, and efforts made to remove the patient as far as possible from the locality and agencies which have caused the disease to develop.

In chronic cases where there is a considerable amount of lung mischief, so that quiescence rather than complete cicatrisation is what can be expected, residence abroad and repeated change from one place to another would probably be found to suit best. Continued expatriation, however, is apt to be trying to such patients, so that a sojourn at home during the summer and first two autumn months, comes in as a welcome change.

Cases of acute pulmonary tubercle, with fever or laryngeal, intestinal, and renal complications, are unfit to be sent far away, if sent away at all. Even in the acute forms, however, a change to a better environment, though it be only a few miles into the open country, may be of the greatest use.

The climates recommended for phthisical cases may be divided into temperate, warm, and cold, the temperate and warm being each subdivided into moist and dry. As a rule it may be said that the colder and dry climates—the so-called bracing localities—are suited for scrofulous cases, for individuals of the lymphatic temperament in whom anæmia is present, for phthisis following or associated with unabsorbed pleuritic effusions or pneumonias, and for cases where the amount of disease is not very extensive.

The warm and moist climates are most suitable for cases associated with much bronchial catarrh and cough, or with laryngeal or intestinal irritation ; for patients with a tendency

to repeated profuse hæmorrhages, for cases of more extensive disease, and for senile cases.

There has been a tendency to believe that phthisis may become aggravated by a change to a warm climate. H. Bennet states * that this is demonstrated by the results of the observations of English and French army surgeons among soldiers; and Pollock expresses his belief that in France, Italy, Spain, Portugal, the West Indies, and Peru, the disease is apt to run a more acute course. To get exact information on this point is a very difficult matter, as there are so many possible sources of error. It seems to be, however, probable enough that the main cause of phthisis,—overcrowding and its associates,—may act more injuriously in a warm climate than in a cold or temperate one; and it seems to me almost certain that in tropical climates the rapid growth of cities resulting from European colonisation, with the rapid accommodation to more sedentary life and less pure air which it has necessitated among the natives, has caused to develop among them a form of disease more virulent than that which now is met with among ourselves.

The climates most appropriate for phthisical disease are best described in works on health resorts; here little more than an enumeration can be attempted.

During the summer and autumn months, any part of our island where the population is sparse and the air pure may be suitable enough. All over, the climate comes under the head of the humid temperate ones, the east coast being as a rule the more bracing, the west and inland being milder. In choosing a locality the patient's inclination, and the results, if any, of previous experiences, should always be consulted; but often a change is beneficial from sea to inland, east to west coast, &c.

For winter and spring it is usually better to go abroad, but

* " Treatment of Pulmonary Consumption by Hygiene, Climate, and Medicine," p. 20.

if this cannot be done, the south coast of England is probably the safest place. The same rule as regards nature of climate holds here as further north, such places as Hastings and Ventnor being rather more bracing than Torquay and Penzance. If a winter must be spent in Scotland, Bridge of Allan may be chosen, and my experience of Morayshire leads me to regard it very favourably. On the Continent, examples of temperate climates are found in Biarritz and Arcachon, which much resemble the South of England, but, enjoying more sun, are probably better.

Warmer localities are, the Riviera (always remembering, however, that the mistral begins about the end of February), the Mediterranean islands generally, Algiers, Tangiers, and Madeira, and very great dryness with warmth can be obtained in Egypt. Probably the best examples of the cold climates are the Swiss Alpine resorts, Davos, Maloja, and St Maurice. The season for these is from November to March, but it is advised * that patients should go there earlier, in the end of August or beginning of September, in order to get accustomed to them before the winter cold sets in.

For still more vigorous cases which can be trusted beyond the boundaries of sanitaria and professional care, there are many localities to choose from—the Cape, the hill lands of South Africa, New Zealand, and Australia, the Rocky Mountains, Canada, and the Andes, &c.

Should a sea voyage be determined on, the best is probably by a sailing vessel leaving in October or November for the Antipodes *via* the Cape of Good Hope, not the Horn, as it entails too great extremes of temperature. If a long voyage seems too hazardous, shorter trips to the Cape or to the Mediterranean may be tried, after which a decision as to the future of the patient can be better arrived at.

The question of *diet* for the phthisical is a very important one. It may be stated, as a general rule, that every effort

* Herman Weber.

should be made to get the patient to digest and assimilate as much as possible, and in prolonged cases where there is fever and debility, all the resources of the culinary art, and all the ingenuity of the physician and the patient's attendants, must be put into requisition to devise a dietetic scheme for each day or week. But in the pre-phthisical stage and in the early stages of the developed disease the dietary is often quite as difficult a point to decide upon; and although in this matter every case must be judged of individually, and the ordinary mixed diet to which a patient has been accustomed must be interfered with as little as possible, any dyspeptic symptoms should be carefully considered from the dietetic point of view. Although theoretically, it is known that non-nitrogenous foods, and more especially their starchy representatives, diminish oxidation, and tend to promote fat accumulation, and that, therefore, the use of these would seem fittest when steady loss of weight is a prominent symptom, it will be found that a diet approaching the diabetic in the paucity of its starchy constituents, will often prove serviceable, digestion will be improved, and the patient's general condition bettered. In cases of the lymphatic temperament with anæmia and a certain amount of *embonpoint*, this plan is specially applicable, but in the nervous or bilious it will often also be found beneficial.

Systematic overfeeding, of such importance in connection with the Weir Mitchell treatment, has had its advocates in phthisis. Debove made use of meat, minced, dried, and powdered, and administered by a tube in quantities of 100 grms. (about 2 lbs.) with milk twice or thrice daily, and Peiper without the tube, has given as much as 300 grms. at a time, with some wine or stomachic.* In their cases some improvement seems to have been manifested. Kurlow † also found increase in weight with such treatment, only, however, temporarily.

* *Brit. Med. Journ.*, Dec. 12th 1885.
† "Centralbl. für klin. Med.," Jan. 2nd 1886.

The massage portion of the Weir Mitchell treatment has also been tried in phthisis. As an adjunct to other treatment, 20 or 30 minutes in the forenoon devoted to it and to passive movements have, in my experience, not infrequently produced some amelioration.

The whey, the grape, and the koumiss cures are by many physicians looked upon as misnomers, it being considered that it is to the localities and seasons in which they are tried, rather than to the articles, that any good results are to be attributed. The same is probably true as regards the mineral waters used in phthisis, though it must be admitted that so little is really known of tissue metabolism, and how it may be influenced, that nothing definite on the matter can be stated.

Practical experience in the use of these as means of treatment seems to indicate that the whey and grape cures are useless except in the proper localities and seasons, and that even in the most favourable circumstances the use of such articles in the recognised quantities may interfere with the taking of food, or induce catarrhal effects in the alimentary tract. The benefits of koumiss drinking can be properly obtained only on the Steppes, but the article prepared by the Aylesbury Dairy Company and the home made koumiss are often of use in this country in the dietary of phthisical and other patients.

Of the mineral waters, the sulphurous, the alkaline, and in lymphatic and anæmic cases, the weaker chalybeate, are stated to be most useful, and in this country Harrogate, and on the continent Ems, Seltzer, Vichy, and a host of others have been recommended.

The "byre" cure,—the beneficial effects of which are said to accrue from the moist warm atmosphere containing large quantities of ammonia and carbonic acid, and the drinking of large quantities of milk fresh from the cow,—is favourably spoken of by Lebert,* and fully described by him.

Among the articles which owe their use in phthisis to pro-

* "Klinik der Brustkrankheiten," Bd. ii., p. 568.

perties partly dietetic and partly medicinal, cod liver oil stands
pre-eminent. Its composition is complex, it contains glycerine,
oleomargarine, and other fatty acids, certain biliary prin-
ciples, phosphorus, chlorine, iodine, bromine, and other salts,
but on which of its constituents its value depends is unknown.
Probably, however, it is on many of them in combination, and
it is of interest to remember the readiness with which this oil
can form an emulsion, and the ease with which it can pass
through animal membranes.

It is specially of use in the pre-phthisical stage, and in the
early stages of the disease before hectic and fever have shown
themselves, in chronic cases in the absence of fever, and in
the phthisis of children. It is stated by Walshe that its effects
for good diminish with the age of the patient, and that "the
few who, having eaten fat freely, yet become phthisical, get
no good from cod oil."

It is often disliked, and in certain cases it disagrees, but
before resigning oneself to its disuse or discontinuance, every
effort should be made to secure its employment. It may be
taken before food, during a meal, immediately after, or about
an hour after, and for its administration at each of these times,
special reasons can easily be invented, but practically this
may be left to the patient's inclination and experience.

If it cannot be taken plain, even in teaspoonful doses, it
may be tried with orange peel infusion, with brandy, whisky,
or rum, with ether, with liquor strychniæ, or with liquor
potassæ and a few drops of oil of peppermint; and care
should be taken to avoid fatty food at the time that the oil is
taken. Where the oil disagrees, the emulsion may be tried,
or the cod liver oil cream may be found suitable, failing which,
glycerine and the glycerol of the hypophosphites are probably
the best substitutes.

Lime salts and preparations of them have long been advo-
cated for phthisis, although the ordinary explanations of their
actions, viz., that they tend to favour calcification of tuber-

cular or catarrhal pneumonic products, to soothe irritable mucous membranes, &c., are anything but satisfactory. They may be given in suitable cases, as lime water with milk, as the chloride of calcium, or as one or other of the several hypophosphites. They seem to be most useful in the phthisis of early years, in the early stages of the disease, and in the scrofulous.

The preparations of iodine and of iron are to be regarded as medicine rather than food, and allusions to them have again and again been made. Some further reference, however, seems now appropriate. With regard, in the first place, to the iodides, it is well to remember that, though little theoretically is known as to their actions, abundant evidence exists clinically as to their value in phthisis. In cases where there is a history of syphilis, their effects for good are specially marked, and as the iodides are beneficial in the scrofulous and rheumatic, in bronchitis and pleurisy, either from their anti-plastic effects or their power of promoting absorption, their applicability in phthisis can readily be surmised. Further, where the pre-phthisical debility can be reasonably ascribed in a greater or less degree to the constitutional effects of such substances as lead or mercury, this remedy is indicated. In plumbers' and printers' phthisis, iodide of potass will often be found most useful.

Apart from these points connected with causal indications, in many cases of phthisis, more especially in the chronic form with fibrosis and cavities, and in the acute cases associated with what seem disseminated broncho-pneumonic foci, the iodides prove of service.

The administration of iron in phthisis, and Trousseau's warning as to the risk of giving this drug to an anæmic individual with a phthisical family history, have already been alluded to. Few physicians, however, are deterred from its use for this reason, and where the administration of iron is properly combined with the removal of the unfavourable

hygienic and dietetic conditions which have originated the anæmia, nothing in the way of injurious consequences will follow. Inasmuch, however, as the common causes of anæmia, indoor life and bad air, are also common causes of phthisis, it is certainly questionable whether or not the development of anæmia, by entailing increased lung function, renders the lungs less liable to phthisical change. In its employment, therefore, care should be taken at the same time to improve any faulty hygienic or other conditions.

Iron is, as a rule, most suitable in the early stages of phthisis, and also where there is anæmia and a soft compressible pulse, as is often the case in lymphatic individuals. The dyspeptic symptoms in such circumstances are often much benefited by small doses of iron and quinine before food. It is contra-indicated in fever, and in cases of cavities and fibrosis where there is a risk of profuse hæmorrhage from rupture of exposed vessels. Indeed, it may be said that iron is applicable in those cases in which digitalis is applicable, and *vice versâ*, and practically, a combination of the syrup of the iodide of iron, or of Parrish's syrup with digitalis, is a prescription in very common use in consumption.

THE PHTHISIS OF CHILDREN AND SENILE PHTHISIS.

THE phthisis of children resembles, in the main, that of adult life. Certain peculiarities have, however, to be recognised, and these, as might be expected, become less and less marked as the age increases.

The first point which requires attention is the period at which, during childhood, the disease is most prevalent. As already mentioned, all observations show that phthisis, very infrequent about the fifth year of life, begins then to increase as age advances, but it is noteworthy that statistics seem to

indicate its somewhat greater prevalence before the fifth year. Thus, a glance at the curve of phthisis constructed from the Reports of the Registrar-General for Scotland (Diagram I.), shows that although during the first five years of life phthisis is comparatively rare, yet that it is present, and that its mortality indicates a progressive diminution from the first to the fifth year. Wyss also, in his article on consumption in Gerhardt's Handbuch der Kinderkrankheiten, quotes statistics to the same effect.

I believe, however, that this prevalence of phthisis, in the very earliest years of life, is more apparent than real, and is due simply to the extreme liability of the organism at these times to bronchitis, catarrhal pneumonia, tubercular lymphatic glands, and acute miliary tubercle. In favour of this view are hospital data, which are of course based upon a more precise investigation of symptoms, and upon a more thorough recognition of pathological change. Thus, out of 115 cases of phthisis attending the Sick Children's Hospital in Edinburgh, the numbers at different ages were as follows :—

1	2	3	4	5	6	7	8	9 years and over.
1	2	1	3	6	14	19	22	50

This shews that, taking phthisis in the ordinary sense of the term, the liability to it is not greater before the fifth year than at or about that period, but that it gradually increases from birth upwards.

From the extra prevalence of miliary tubercle in early life, however, the phthisis of that period is peculiar, in that although we have, as in the adult, a pneumonic and fibroid form, the tubercular, primarily or secondarily, is very frequent. This, by its tendency to spread to other organs, gives rapidity to the downward course of the disease, and explains the statement that the phthisis of early years is more acute and rapid than that of adult life.[*]

[*] Pollock, *ibid.*, p. 253.

But the fact that true pulmonary phthisis is relatively rare in early life, and that, as pointed out in the first Chapter, the nutritive powers of the organism are then high, would lead us to suppose that a non-tubercular phthisis, when existent, would then present more favourable aspects. This has certainly been my experience, and among authors I find that West draws attention to the protracted course followed by the disease in many cases, and states that in such the child may " live with but little deterioration in its condition until measles or hooping-cough imparts a fresh stimulus to the disease, or excites some fatal attacks of bronchitis or pneumonia."

In children, therefore, although it may appear contradictory, it would seem that the phthisical affection may be either more rapid or more chronic than in the adult, the former corresponding to the tubercular type, and owing its rapidity mainly to tubercular complications ; the latter corresponding to the pneumonic and fibroid types, running its course for a long period uncomplicated. Further, it would seem that the former type is proportionately common in the early, and the latter in the later years of childhood.

The symptoms of the more chronic forms in early life present a noted peculiarity in their comparative latency. Observing in passing that this latency is not confined to phthisis, but that pneumonias, and more especially pleurisies, are similarly liable to be overlooked, it is of the greatest importance to remember that frequently all that for a long time is remarked is a failure of the general health. The child is out of sorts, fretful, complains of vague pains, has lost appetite, and is disinclined for exertion. In time, however, symptoms show themselves, indicating more definitely the nature of the malady. Cough is present, but slight and frequent rather than troublesome ; it is noticed by the friends rather than drawn attention to by complaint, or by any appearance of suffering on the part of the patient. Expectoration is rare,

to a large extent because it is swallowed, and possibly for this reason also hæmoptysis is seldom met with. Nevertheless cases of fatal hæmorrhage are not uncommon. West quotes seven such, and by Henoch, Wyss, and Rasmussin cases have been reported at the ages of three years, one year, and three and a half years respectively, all being caused by rupture of small aneurismal dilatations. Fever is rarely so high as in the adult, and the same is true of hectic ; if there is sweating, it is usually limited to the head and face. Corresponding to the general mildness in the symptoms, the appetite usually remains to some extent, and the characteristic emaciation of phthisis is less extreme.

The physical signs are similar to those of adult phthisis, but it is important to note that signs of cavity formation are comparatively rare. This may be explained in part by supposing that in the tubercular form the rapid spread of the disease and the occurrence of complications leave little time for their formation, and that in the pneumonic and fibroid the continuous growth of lung tissue, and the yielding nature of the thoracic parietes, render the conditions necessary for their occurrence less favourable. In the earliest years and even months of life, however, cavities may be met with. Probably the earliest example is one given by Demme, in which a cavity was found in a child twelve days old, and in this case it has reasonably enough been suggested that the mischief which led to its formation had existed intra-uterine. Other examples have been given by Henoch, Steiner, and Weber of Kiel, the latter observer believing them to be commoner under two years of age than in older children. According to that author, also, the position of cavities in the lung in young children seems to vary with age, for he states that whilst under three months they are usually in the lower lobe, above this age, and up to the second or third year, they are as frequent, or perhaps more frequent, in the upper. According to Wyss, the right lung is the one usually affected by cavities

in children, and it would seem that in such cases they are catarrhal-pneumonic in origin.

These considerations indicate to us a further peculiarity, viz., that in children's phthisis the apices are not so uniformly the seat of the disease as in the adult. For this the explanation probably is, that in the first place the catarrhal pneumonia which often originates the disease is more prone in the child to affect the lower lobes; and, secondly, that in the child, abdominal tubercle forms frequently the starting point of the disease, and causes direct involvement of the bases of the lungs by infection through the diaphragm.

In the child the indications by which the different types of the disease can be recognised are similar to those of the adult, and need not therefore be attended to in detail. It is, however, to be remarked that although, as in adult phthisis, no hard and fast line can be drawn between them, the distinction of the tubercular from the other two is usually specially evident, while the pneumonic and the fibroid merge more imperceptibly into one another. In determining the type, age, heredity, and unilateral or bilateral existence of the disease, are of importance; and it is also to be remembered that whilst the acute tubercular type, with its tubercular complications, is common as a sequela of some other disease, as measles, hooping-cough, or typhoid, the more chronic pneumonic or fibroid ones more usually show themselves developing gradually out of a previously healthy state, and having remained for long unnoticed, are apt to present to the physician, on first examination, physical signs much in excess of symptomatic indications.

Corresponding with the marked distinction between the tubercular and the inflammatory types of the disease, and taking into consideration also the fact that the whole period of childhood is brief as compared with that of youth, adolescence, and adult age collectively, the duration of the phthisis of early life presents great variations. Rilliet and Barthez

give the extreme as two months to two years and over ; West gives from a few weeks or months to two, three, four, or five years.

In the pulmonary phthisis of children, death is, less frequently than in the adult, due to the disease itself. In the tubercular forms, of course, the involvement, previous or subsequent, of other organs, and the occurrence of acute miliary tubercular, is specially likely to bring about the fatal issue ; but in the pneumonic and fibroid forms, where, as West says, " the child leads a valetudinarian existence for years, improving in health and gaining flesh in summer and losing in winter," intercurrent attacks of bronchitis or pneumonia may be the immediate cause of death. Pneumothorax is specially rare in children.

As regards prognosis little need be said. The disease, once well marked, is almost always fatal. In the pneumonic and fibroid forms, the long-continued comparatively healthy appearance of the patient may, even in the presence of a large amount of disease in the lung (*e.g.*, dulness and crepitation over the two upper interspaces), incline us to hope that a complete arrest may be secured. This, however, seldom occurs ; and if, some six or twelve months after the commencement of appropriate treatment, we find that physical examination shows no diminution in the extent of the disease, our ultimate prognosis must be very grave. In the face of the general mildness of the symptoms and good appearance of the patient this may seem gloomy, but it simply indicates to us the necessity of its more early recognition. As we have seen in a previous chapter, complete healing of a lung lesion can only occur when the amount of lung tissue destroyed is comparatively limited, and no matter how favourable the circumstances and how slow the progress may be, the chances of this favourable result diminish rapidly as the disease extends. In children affected with pneumonic or fibroid phthisis the healing power is certainly greater than in adults ;

and were it not that the period of childhood has to pass
through puberty to adult life, in which passage the tissues,
and specially the lungs, have to meet the extra strain on their
resources necessary for growth, their phthisis would probably
present a much more favourable aspect. The physician's
duty therefore is, remembering the latency of its symptoms,
carefully and thoroughly to investigate the physical conditions
of the lungs in all cases, and so to secure for his patient appro-
priate treatment before extent of disease renders its eventual
success hopeless.

Senile Phthisis.—Pulmonary consumption is acknowledged
to be distinctly less frequent in old age ; but it is important to
notice that most observers who have investigated the subject
incline to consider that, whether originating during these years
or simply developing then from seeds sown at earlier periods
of life, it is much more common than is usually supposed. As
compared also with adult life, it is apt to appear rarer than it
really is, inasmuch as the total number of people living at the
ages of, let us say, sixty, seventy, or eighty years, is much less
than at twenty, thirty, or forty. Taking, however, this into
consideration, that is to say, taking the mortality from
phthisis at each year relatively to the total number of indi-
viduals living at corresponding periods, a distinct diminution
is clearly remarked. The curve, Diagram I., clearly shows
this, though it demonstrates the existence of the disease till
the very close of life. Isolated examples of its occurrence at
very advanced ages have been given by Day, Durand Fardel,
Mettenheimer, Vulpian, and others.

A peculiarity of the phthisis of old age to which attention
is drawn by most observers, is its comparative chronicity.
This, which indeed is only what its infrequency would lead us
to expect, is due to a variety of causes, which have been already
alluded to, and which need not again be discussed. It may
only be stated that they are in part general and in part local.
As an example of the former, there is the relatively slight

tendency during advanced years to tubercular formation (aged phthisis contrasting thus markedly with childhood's), and of the latter there are the structural changes in the respiratory apparatus. Of these the increase in size of the pulmonary air cells, the obliteration of many of the capillaries, and the more watery condition of the lungs as a whole, are probably the most important, for, as leading to an increase in the " besoin de respirer," lung function will so far be favoured.

The history of a case of phthisis in the aged is usually that of one or more bronchitic attacks terminating in catarrhal pneumonia, and the disease is for the most part of the pneumonic or fibroid type. As above stated, the tubercular complication is rare; it is by no means, however, unknown, and although in the instances in which it occurs it usually limits itself to the lungs, examples of its extension have been reported.

The symptoms of the disease are remarkable for their latency. Commenting on this matter, and pointing out that, as Gillette has demonstrated, this latency applies to other affections in the aged, as gall stones, cancer, &c., Charcot contrasts this with children's disease, stating that, although in infant and senile pathology the tendency to a want of connection between the local lesion and the production of general symptoms may exist, " yet it is in an inverse direction. At this age" (*i.e.,* in early years) " reaction is, as it were, exaggerated and tumultuous, the violent disturbance of function by no means demonstrating a grave disease. In old people, on the contrary, the organism remains, so to speak, unmoved in the presence of the gravest changes." Such an explanation does not meet the circumstances. It may apply to some extent as regards senile phthisis, but it is evident that the conditions which we have already noted in the aged as explaining its slower course will account also to some extent for its symptom latency. In the case of the child, however, it seems more probable that as phthisis is a disease not associated with pain,

and therefore not likely to affect the young subject injuriously through its unstable nervous system, the symptomatic indications of its evil effects are, like the effects themselves at this period, kept in abeyance as the result of the great energy of the nutritive or vegetative functions. We have already seen that where phthisis runs an acute course in children, it is mainly due to tubercular complications.

Cough is present in senile as in other phthisis, but is seldom so very troublesome, and the expectoration is less. Hæmoptysis is unusual and seldom profuse, but Durand Fardel gives instances of its occurrence to an extreme degree in an advanced age, viz., seventy-five and eighty years. Day and Durand Fardel state that, in the slighter forms in which it is apt to occur in old people, it is of comparatively little consequence, and believe that it often takes place compensatory to the bleeding of hæmorrhoids.

Fever is present, but commonly to a slighter extent than in adults ; and in judging of its intensity it is necessary to bear in mind that in normal old age the pulse and respirations become slightly accelerated. At this period, too, as Charcot points out, there seems to be a greater difference between the internal and external temperature of the body than in earlier years, hence the rectal, rather than the axillary, temperature should be taken as a guide. The skin is comparatively cool and dry.

Associated with the rest and quiet which old age requires, dyspnœa is practically uncomplained of in senile phthisis, and as respiration, though perhaps slightly accelerated, is performed quietly, and as pleuritic attacks are uncommon, pain is seldom present. On the other hand, emaciation is apt to be great, not so much, however, apparently, as the result of the increase of the waste of the body as of the diminution of the supply, the anorexia being often extreme.

The tendency in the phthisis of advanced life to cavity formation seems rather marked ; and whilst this may be ascribed, on the one hand, to the rigidity of the chest walls,

and on the other, to relative atrophy of lung tissue, it may be surmised that this latter, although favouring cavity formation, will, by involving the blood vessels in the atrophic process, to some extent act in guarding against the formation of the aneurisms, which, associated with cavities, are a more frequent cause of mischief in earlier years.

In senile phthisis the mischief tends to remain more limited. The affection is rarely bilateral, and, as already mentioned, tubercular extension to bronchi, larynx, intestines, peritoneum, brain, &c., is very uncommon. Mettenheimer, however, gives examples of such, and it is worthy of note that, as complications in the aged, various forms of degeneration, fatty heart, atheromatous vessels, and cancer may be met with. Pollock observes that the arcus senilis can often be detected in the phthisical at an earlier age than usual.

It would be interesting to discover the proportions of apical to basal cases in senile phthisis. Pollock found of the latter 8 instances in 174 cases above the age of forty-five, and as the proportion at all ages is about 1 in 70, this seems to show a greater liability to the basal affection in advanced life. It is not what theoretically might be expected, for the movement of the upper portion of the chest being then less marked owing to deficient action of the ribs and tendency to calcification of their cartilages, the diaphragm is the main respiratory organ, and the apices will perform their function with diminished activity. The fact, however, that such statistics show no distinction between basal phthises in the ordinary sense of the term, and phthises the results of pleurisy or acute pneumonia, or basal affections, developing secondarily to abdominal tubercle, renders it impossible to draw from them any trustworthy conclusion. It would seem that croupous pneumonia of the upper lobe is more frequent as age advances, but there is no doubt that at corresponding periods, catarrhal pneumonia of the lower lobe is not uncommon, and readily ends in a phthisical process.

The physical diagnosis of phthisis in the aged is apt to be attended with difficulty. In our endeavours after it we must remember that the entire chest parietes are more rigid owing to more or less bony union between sternum and ribs, and to increased curvature of the spine, and that therefore the condition of the underlying lung is less easily discoverable by percussion. Further, with quite normal lungs the infraclavicular regions are more, and the suprascapular regions less resonant, in the aged than in the adult. The auscultatory signs are also rendered less distinctive by the fact that normally they may present a harshness and prolongation of the expiration and increase in the vocal resonance, and that, as Loomis says, since " it is an almost physiological condition for old people to have a bronchorrhœa, mucus râles may be constantly present during the whole period of advanced life." Such râles will, of course, be localised at the bases of the lungs ; but the catarrhal condition of which they are the manifestation being more general, the detection of abnormalities at other parts of the lung is rendered less easy.

Corresponding with the relative infrequency of senile phthisis with the latency of its symptoms, and with its lessened tendency to tubercular complications, the duration of the disease is apt to be prolonged. To such an extent may this occur that frequently, when death takes place, so little of any suffering due specially to the malady is present, that its existence, unless known previously, could hardly have been diagnosed. For similar reasons the fatal termination is not infrequently due to some concurrent or intercurrent nonphthisical lesion.

It is interesting to note that according to Williams and Pollock, the retarding influence of age upon the disease is more conspicuous in the female sex, an opinion which is borne out by the data given by the curve (Diagram I.), which shows that after fifty-five the mortality from phthisis is, on the whole, proportionately less in women.

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APPENDIX.

MICROSCOPIC EXAMINATION OF THE SPUTUM IN PHTHISIS.

THE examination of the sputum as a factor in the diagnosis of phthisis is valued differently by different observers, probably because to a great extent its importance in this way, as compared with that of the physical examination of the chest, is apt to vary inversely with the skill of the individual physician in one or other mode of diagnosis. It is certain that but few cases occur in which symptoms and physical signs do not afford sufficient evidence of the disease as far as diagnosis is concerned, but the examination of the sputum is always of value. It has been specially so in my experience in the phthisis which, supervening on repeated bronchitic or asthmatic attacks, occurs in individuals somewhat advanced in life, whose chests are emphysematous, and whose chest walls are rigid. It has also been of special advantage as a negative sign in bronchiectatic cases.

In the sputum the matters to be looked for are, of course, lung tissue and the bacillus, and I agree with Dr Troup in considering the former as being of the two practically the more important, that is to say, in considering that in phthisis, the presence of elastic tissue in the sputum is as sure an indication of progressive lung destruction as is that of the bacillus. It is to be remembered here that lung tissue may be met with

in other conditions than phthisis, notably in pulmonary gangrene and abscess. Such conditions are, however, relatively infrequent, and by the clinical history and physical signs, can usually readily be distinguished from phthisis.

Lung tissue may be demonstrated microscopically in either of two ways.

(*a*) By placing a particle of the suspected sputum on a slide, with or without a drop of a 30 per cent. solution of caustic potash—covering and examining.

(*b*) By boiling the twenty-four hours' expectoration with an equal quantity of the caustic potash solution in a flask till the mixture becomes fluid, adding to it four times its bulk of water, allowing to stand in a conical glass for twelve hours, and examining the deposit which occurs.

In either of these ways the elastic fibres may be detected, showing their clear outlines, slightly yellow colour, and curling circular arrangement—the skeletons of groups of pulmonary air cells. When laryngeal phthisis is present, elastic fibres from the larynx may be found. These may be recognised by their being finer, and by the absence of the circular arrangement.

The process of detection of the tubercle bacillus in sputum may be divided into three stages :—(1.) The spreading and drying of a particle of suspected sputum on a cover glass ; (2.) its staining ; and (3.) its examination with the microscope.

1. *Spreading and drying the suspected sputum.*

* " To obtain an average specimen of the sputum to be scrutinised, it is well to pick a portion here and another there, to mix them thoroughly, and from this blend to select the particle to be spread by needle if preferred ; or by placing it between two cover glasses, pressing them together, removing by blotting paper the superfluous stuff which exudes round the edges, drawing, not lifting them asunder, when the opposed

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* Troup, *Sputum*, p. 119.

surface will be left smeared with a desirably thin film of the suspect. Obtained in this way or that the film should be allowed to dry thoroughly, protected from dust in the air of the room, or if dessication is to be hastened a little, the glass may be held high above the flame of gas or spirit lamp, the armed side, of course, uppermost. If heat is too rapidly applied, the albuminoids, not yet being dehydrated, will infallibly coagulate, and instead of being homogeneous and transparent, as they should be, will become opaque, and precipitates will form when the staining solutions are added. To fix the albumen securely, and to bake the sputum to the cover-glass so that its dropping off will be rendered impossible, the glass, after perfect drying, and with its free surface undermost, should be slowly drawn three times through the Bunsen or spirit lamp. By so doing Koch has shown that the bacterial forms are not in any way altered, that the albumen becomes insoluble, and that no precipitates, on addition of the stains, will obscure either the preparation or the proper interpretation of it."

2. *Staining.*

For this purpose many colouring matters have been recommended, for a full description of which reference must be made to special works on the subject. For ordinary practical use the double stain of Gibbes, as prepared by Beck, or the Neelsen stain, will be found to answer very well, and are the only ones the method of employment of which need here be described.

Gibbes' Method.—A small quantity of the staining fluid is poured into a small-sized watch glass, and the cover-glass, with the film side undermost, is dropped flat upon it so that it floats, care being taken that no air bubbles are resting against its under surface. Gentle heat is then applied by holding the watch glass with its contents over the flame of a spirit lamp till it steams slightly, and the time then allowed for the

staining to occur is five minutes. At the end of this time the cover-glass, grasped lightly with the forceps, is removed, and immersed and gently washed in a quantity (about an ounce) of methylated spirit, until the washings no longer show a blue colouration. It is next set aside to dry, which it does very rapidly, and then mounted on a slide in balsam. Should it not be considered desirable to mount and preserve the specimen, it may be examined placed on a slide in a drop of water or glycerine. The bacilli appear red on a blue ground.

Neelsen's Method.—For this are required a solution of Fuchsin, a 15 per cent. watery solution of sulphuric acid, and, if a contrast stain be desired, a solution of methylene blue.* The cover-glass, with its film, is placed in the manner above described on a small quantity of the Fuchsin solution, and the heating, and the time allowed for the staining, are the same as in the Gibbes' process. At the end of the five minutes the cover-glass, grasped with the forceps, is dipped for a few seconds in the sulphuric acid solution, and then well washed in distilled water. After allowing it to get thoroughly dry, it may be examined in water or glycerine as before, or preserved in balsam. The red bacilli will then be detected on a red ground, but if the contrast stain is desired, it is, after being washed, dipped for a few minutes in the methyl blue solution and again washed. In the latter case the red bacilli appear on a blue ground, as with the Gibbes' double stain.

3. *Examination with the Microscope.*

Any good microscope having a magnifying power of 350 or 400 diameters will display distinctly enough the tubercle bacillus, and such an instrument, fitted with an Abbé condenser, will probably be found sufficient for all ordinary work. Of course, in doubtful instances, where the bacilli, if present at all, are only in very small numbers, a positive

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* From most of the dealers in scientific apparatus, &c., these solutions can be obtained made up and ready for use.

statement as to their absence would not be of value unless more elaborate instruments and wet lenses had been employed. In all cases the film must be carefully searched, care being taken, not only to go over its entire surface, but to explore by careful focussing every part of its thickness.

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INDEX OF AUTHORS.

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